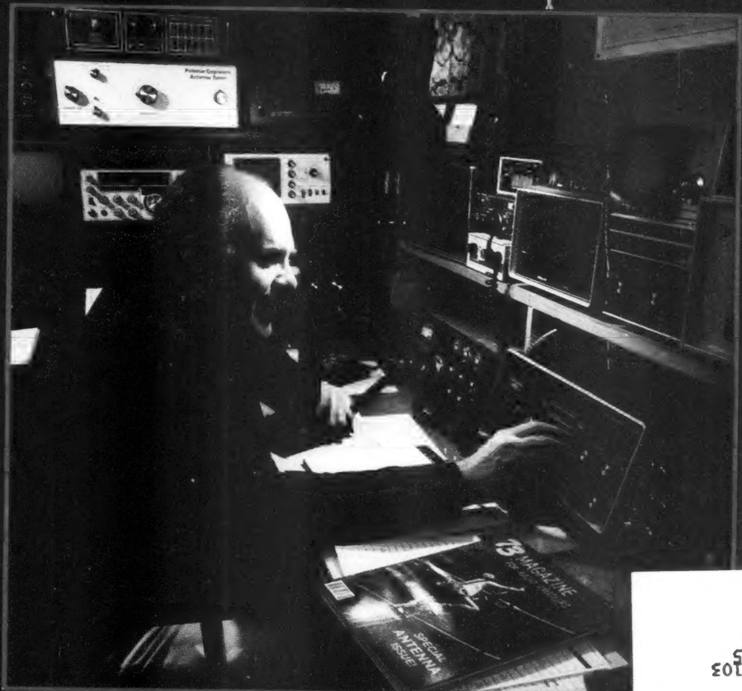
73 Amateur Radio Today

35th Anniversary Issue

ANTENNAS!

Loop Antenna · Discone Antenna
J-Type Vertical Antenna · Bridge Checkers
Longwave Plus DX · Tuners



73 REVIEWS

Sony ICF-SW100S Pocket SW Transceiver

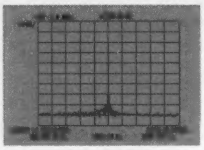
Icom IC-738 HF Transceiver

Expand Your Horizons to 6 Meters!

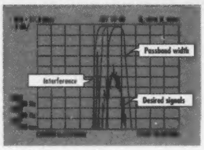
NEW from ICOM

IC-736: 6 Meters and HF!

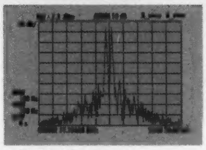
- ☐ HF and 6 Meters!
- ☐ 100 W Output for Both HF and 50 MHz
- ☐ Internal AC Power Supply
- ☐ Automatic Antenna Tuner (Covers 6 M to 160 M)
- ☐ Dual Antenna System
- ☐ 100% Full Duty Cycle
- ☐ Newly Developed DDS Circuit for 1 Hz Fine Tuning Resolution
- ☐ Quick Split Function (with pre-programmable offset)
- ☐ MOS-FET "Class A" Audio
- ☐ Multi-Function Meter (4-in-1)
- ☐ Double Cooling Fan
- ☐ Selectable Filters
- ☐ 10 dB Pre-amp, 20 dB Attenuator
- ☐ Built-in Electronic Keyer
- ☐ RIT, ΔTx, ΔRx
- ☐ 10 Key Pad
- ☐ VOX
- ☐ RF Gain
- ☐ 101 Memory Channels
- ☐ Passband Tuning
- ☐ AF-type Speech Compressor
- ☐ CW Full Break-In
- ☐ Notch Filter
- ☐ Noise Blanker
- ☐ Large Display



Transmitter C/N Ratio



PBT Characteristics



3rd IMD Characteristics

Now you can work all of the HF bands AND have access to one of the most exciting amateur bands – 6 M! The IC-736 is an all band, all mode transceiver with a general coverage receiver. Only an antenna, coaxial cable and AC outlet are necessary to get up-and-running with this rig. Cutting edge features and "plug 'n play" operation make the IC-736 a "complete station in a box!"

The IC-736's compact and cleverly designed **Automatic Antenna Tuner** has preset memories for each 100 kHz step, thereby providing very high speed tuning. Tunes all ham bands plus 6 M!

Equipped with **2 Antenna Connectors**, the IC-736 includes an **Automatic Antenna Selector**. In each band, the band memory memorizes the selected antenna so you don't need to change an antenna manually each time you change the operating band.

The IC-736 employs power **MOS-FET's** in the driver and final amplifier stages, providing a clean, 100 W of output power over all of the ham bands as well as the 50 MHz band.

An **Aluminum Die-Cast Frame** and **2 Large Cooling Fans** help stabilize the IC-736's PA circuit to obtain 100% full duty cycle operation. Performance you can count on under the most demanding of conditions.

CW fans will love the IC-736. The **Full Break-In Function** (QSK) allows you to receive signals between transmitted keying pulses (semi break-in is also available). **Separately Designed CW Key Jacks** allow you to connect both a memory keyer and a paddle – great for contest operation!

The **Double Band Stacking Register** memorizes 2 frequencies along with modes in each band so it can be used like 2 VFO's in one band.

Up to 10 **Electronic "Memo Pads"** are available. This is especially useful during contests or while DX hunting. When catching a station you would like to temporarily store, simply push the memo pad-write button. The frequency and mode is automatically stored in a memo pad so you can continue band searching.

For interference rejection, the IC-736 has **Passband Tuning** and a **Notch Filter.** During crowded band conditions, these two functions can be used in combination, providing an extremely effective method of reducing most types of interference.

The **RIT** and **ΔTX** functions independently change the receive or transmit frequencies, respectively. Great for split frequency operation or for compensating for the frequency drift of another station.

The IC-736's offset frequency for **Quick Split** Function can be pre-programmed. A **Split Lock** function prevents you from mistakenly changing the receive frequency while changing the transmit frequency.

A newly designed **DDS** (Direct Digital Synthesizer) provides frequency resolution to an exacting 1 Hz. Rotate the main dial and experience the comfortable analog feeling of fine tuning. One complete dial rotation is equal to 200 Hz.

Call (206) 450-6088 for FREE Literature!

View a video demonstration of this product at your participating ICOM dealer today!

ICOM America, Inc. Corporate Headquarters
2380-116th Ave. N.E., Bellevue, WA 98004

ICOM®

Experience the Quality®

THE TEAM

PUBLISHER
Wayne Green W2NSD/1

SENIOR/TECHNICAL EDITOR
Wayne Green W2NSD/1

MANAGING EDITOR
David Witham

EDITORS
Joyce Sawtelle
Victor Lapuszynski

CONTRIBUTING EDITORS
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KØOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

ADVERTISING SALES MANAGER
Gerry Foss
1-603-924-0058
1-800-274-7373
FAX: 1-603-924-9327

TECHNICAL DRAWINGS
Mike Nugent WB8GLQ
Writers

GRAPHICS MANAGER/ PAGINATION
Linda Drew

DESIGN/PRODUCTION
Joan Ahern

GRAPHIC SERVICES
FilmWorks, Inc.
Antrim NH

CIRCULATION
To subscribe: 1-800-677-8838

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
1-800-677-8838

Foreign Subscribers
1-609-461-8432

Reprints: $3.00 per article.
Back issues: $4.00 each.

Write to *73 Amateur Radio Today*, Reprints, 70 Route 202N, Peterborough, NH 03458.

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

73 Amateur Radio Today

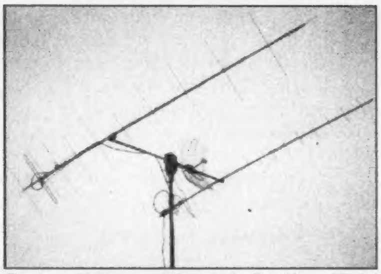
September 1995
Issue #420

TABLE OF CONTENTS

FEATURES

DEPARTMENTS

REVIEWS



Two large KLM crossed Yagis and a Bob Myers "S" dish for Field Day sattellite work. See Hamsats on page 64.

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: That's vintage Wayne in the hamshack. Sure been at it awhile, spreadin' ideas all over the air. And behind him is a pair of Cushcraft Model A3S antennas that can help do the spreadin'.

FB

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

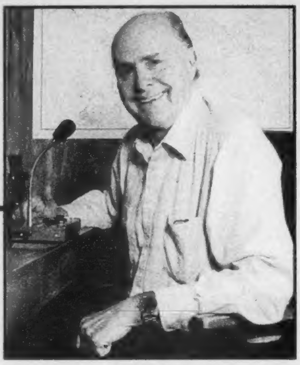
73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. Entire contents ©1995 by Wayne Green Inc. No part of this publication may be reproduced without written permisson of the publisher. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: You have now been legally obliged, by the mere act of reading this, henceforth to act with all the duties and responsibilities befitting the status of a human being. You must now behave with dignity and kindness toward all beings, honoring the ancient and educating the young. And if you're obnoxious on the air, my cousin "Big" Bruno's gonna find you with his Doppler.—Vic

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



Ooops!

In my July editorial I mentioned the Virginia Beach Hamfest as being in July. Wrongo! It's September 23–24 and, if you are within any kind of driving distance, I expect to see you there. No excuses. Yes, of course, I'll be talking. And talking. Well, I kept 'em entertained for a couple of hours at the recent Edmonton hamfest. More like three, I guess. Nobody left and everyone was laughing. I'll be at the Queen Mary hamfest over Labor Day, but I haven't been asked to speak (yet). I'll try to bring some tapes to tide the deprived over if the ARRL can't find any time for me on their program. I'll have some of my books there to autograph, too.

Good Grief, 35 Years!

When I started publishing *73* with the October 1960 issue, I was too busy living in the present to even imagine that 35 years later I might still be at it. It was something which I felt was needed at the time; something I enjoyed doing. So I sold everything I could and scraped just enough money together to print the first issue. That's the sort of a gamble only a naive entrepreneur would make.

At 38, it never occurred to me that I'd still be publishing the magazine when *I* was 73. But then, who really plans their future out for years? I took opportunities as they presented themselves, with little thought to the long run, other than investing in building as many skills as I could and reading endlessly.

The big landmarks in my life were my interest in amateur radio, which began in earnest in 1938; my four years in the navy during WWII and the superb electronics education I was provided; my interest in Dianetics in 1950, which was a major turning point for me; my first entrepreneurial adventure: manufacturing loudspeakers; my entry into ham publishing, starting *73* in 1960, FM and repeaters in 1969, and microcomputers in 1975; the sale of my microcomputer empire and entry into the music business in 1983; my involvement with the New Hampshire Economic Development Commission in 1991; and my venture into cold fusion in 1994.

It was amateur radio that got me to go to Rensselaer Polytechnic Institute, and then into the navy as an electronics technician. This led to me working for Airborne Instruments, doing R&D for the Air Force, where I took a new microwave antenna design and applied it to loudspeakers. It was amateur radio that got me into publishing, starting with a RTTY newsletter in 1951.

Amateur radio has brought me thousands of friends and years of enjoyment.

Psychokinesis Anyone?

You no doubt missed the article in the April *Wired* on the Princeton Engineering Anomalies Research (PEAR) laboratory, where they have confirmed the ability of minds to influence matter. It turns out that about two-thirds of the people tested were able to influence random events. Of course, there were a few people who are completely off the charts. Endless tests have shown that it doesn't make any difference where the people are being tested. The effect works just as well in the same room as halfway around the world or out in space.

I remember a video of a psychic changing the surface tension of a jar of water from hundreds of miles away. This was shown at the ISSSEEM (subtle energies) conference in Monterey in 1993. I hope to have more to report on this year's conference in Boulder (which by now you've missed, despite my entreaties to attend). The same psychic was able to disturb a cloud chamber from afar.

But then, if you've been getting the books I've recommended, you know about the incredible ability of your cells to keep in touch with each other, no matter how separated they are from you.

Now, to put this in ham terms, please don't tell me you have nothing more to talk about on the air than your rig and antenna. Or the weather. There's a whole world out there that we're just beginning to explore. We don't know how the mind works. We need to know more about death . . . and never mind what your religion has taught you. When millions of people over thousands of years have a near-death experience and then come back to report similar experiences, it's almost enough to make a person think.

I talked with a chap in Florida who claims he can teach people to move matter with their minds. He says he can spin a whole room full of pizza pans from anywhere he is, and has done it under the most carefully checked scientific circumstances.

One of the problems with exploring the mind and consciousness is the number of people taking advantage of the vacuum of information in this field. They're out there waiting to take advantage of the gullible at every turn. But if you throw the baby out with the bathwater, you're just refusing to explore uncharted territory . . . if you don't mind my metaphors.

One only has to look at the endless examples of scientific resistance to evidence to begin to question our authorities. I've written about stomach ulcers, in which the medical establishment refused for years to even look at the evidence that they might be connected to a microbe: *Helicobacter pylori*.

The more you read about carefully researched near-death experiences (NDEs), angels, contactees, UFOs, reincarnation, and so on, the more you realize that thousands to millions of people have for some reason been having similar experiences all over the world. What do you know of the research of Sir Crookall, Wilhelm Reich, Royal Rife, Gaston Naessens, and other unsung pioneers?

Homeopathic medicine was a big and successful healing art here in the 19th century. My great grandfather was the town doctor for Littleton (NH) and was still being talked about appreciatively by the townspeople when I was a kid, 30 years after his death. He was a homeopath. Now, if you've been keeping up, you know that allopathic doctors mounted a battle against the homeopaths in the 1920s and put them out of business in America by taking over all of the American teaching hospitals. However, homeopathy still lives in England, where recent double-blind research has shown that the basic theory does work, though there is no scientifically accepted explanation for how.

The more I read, the more convinced I am that millions of people are suffering and dying needlessly, all as a result of the AMA-FDA and the supporting insurance companies refusing to look into even the strongest of research data on alternatives to the use of drugs and surgery as a solution to our sickness problems.

Oh yes, lest I forget. If you have some unfortunately overweight people in your ham club, you could help add quite a few years to their lives by getting them a subscription to *73* and let me keep after them to give up their beer and doughnut diets and shift more to fruits and veggies. No, I'm not a vegetarian or anything. But it doesn't take a rocket scientist to figure out that your body has to keep rebuilding itself from the food you eat, so it's going to last a lot longer if you provide what it needs. Coffee and danish are new additions to our diets. The human body developed over the millennia to work on meat, vegetables, and fruit, not Dunkin Doughnuts, beer, Big Macs, and fries.

Continued on page 74

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Joseph Falcone, Att'y (no call given) I have been reading your *73* editorials for some time now. At first I thought you were simply "off-the-wall" and interested solely in eliminating amateur radio Morse Code exam requirements so you could sell more magazines and other stuff to more licensees.

But, after reading your editorials, I realized that you are in fact a visionary who is quite upset that people in America, including amateur radio operators, appear to be content to sit on their butts and let the world pass them by. You consistently point out that commercially connected computers can pass information millions of times faster than some amateur radio modes, and you urge the amateur radio operators to forget about long boring 75 meter phone QSOs and allegedly "meaningless" CW QSOs. But, Wayne, you are missing the point. Amateur radio is not going to compete with the Internet or cellular phones in efficient ways to communicate. Those modes of communication have passed by amateur radio in pure efficiency and capital investment. What amateur radio has that the commercial communication operations will never have is: (1) amateur radio operators who volunteer to be mobilized in an emergency to provide true "emergency" communications; and (2) the ability to provide education and training to America's population about basic electronics.

By keeping CW in use, amateur radio provides a means by which its participants can build and use very basic equipment to communicate. Let's face it, the average person will not be able to design and build a new, improved 486 computer chip, with its three million transistors. But, the average person can build a small QRP transmitter and learn how transistors and other basic components work.

Back in the 50s you and amateur radio were in the forefront of technology. Today, that just is not so, and will likely never happen again. Smell the roses, Wayne! Our store-bought equipment is so complicated today that we are lucky if we can figure out how to use it, much less understand how it really works. Forget about actually building a TNC or 2 meter HT. That simply does not happen any more, and will never again.

If we want to keep amateur radio valuable to this country, and not just a cheap way to get around using cellular phones and long-distance telephone lines, we must promote the use of CW in amateur radio to insure that the hobby is not simply a group of people who like to chat on the two meter repeater systems that Uncle Wayne invented 20 years ago. Are the two meter repeater operators any more productive than the windbags on 75 meters you so disdain?

All the "hot" technology is in the UHF/VHF area. The UHF and VHF amateur radio bands are "code free." All the "scientists" that you and others say want to rush into amateur radio, but are prevented because of a 5- or 13-wpm Morse Code requirement, can easily obtain a no-code license and can experiment to their hearts' content on the higher bands. Just allow the old HF bands to be the training ground for people who want to know why electronic things work, rather than what the buttons do.

When I look at the main Japanese ham magazine, running 500-600 pages every month, packed with innovative and some highly advanced construction projects, I see what American hams used to be able to do—and you claim they will never again. But then the Japanese have not been saddled with the code requirement for decades. Joe, I have never had any quarrel with the code as a way to have fun, only with using it as a way to freeze out new hams, which it has done and is still doing very effectively. Maybe you haven't noticed that over 50% of the American hams today are Novices or Techs. For some weird reason you seem to believe that the only way you can get hams to use CW is to force them by law to learn the code. How typical of a lawyer! I have a news flash for you, Joe, the need for ham emergency communications is dwindling. Our ability to provide basic electronic training has been almost totally destroyed by the ARRL memorization system for passing license tests. So I'm sitting up here in the beautiful mountains of New Hampshire smelling something, but it isn't roses, as more and more Americans become lawyers instead of engineers. Have I really missed the point? . . . Wayne

Cecil Moore KG7BK I've just got to take issue with your June review of the SGC-230 automatic antenna tuner for mobile operation. You say it doesn't work well in the trunk. Well, then don't install it in the trunk. You say it doesn't work well with coax. Well, then don't use coax. Implying that it's not a good automatic tuner for mobile use is just not true. It sure outperforms my old system on the higher bands. Since it's weather-proof, it is logical to install it on a grounded rod mounted to the bumper. Mine is a 5/8" piece of threaded rod bolted to the trailer hitch hole. A standard antenna mount is located at the top of the grounded rod. My antenna is a 13-foot whip fed by 2 inches of wire from the SGC-230. There is no coax involved. The whip is a resonant quarter-wave on 17m and does an excellent job on 20m. It outperforms my old tuner on 15m, 12m, and 10m because of the gain associated with an antenna longer than a quarter-wave. The 13' whip and the SGC-230 is only one S-unit down from a resonant Bugcatcher on 40m. I hope SGC doesn't lose any sales because of your disinformation. It is an ideal solution for l0m-20m automatic tuning mobile operation.

John Slivka WA2X I want you to know that I really appreciate your column every month in *73*, and I view your position as really the chief spokesperson for amateur radio. Keep the great ideas flowing! I've wanted to write to you for a long time because I'm concerned about the future of ham radio and the spirit of camaraderie and good will which have always been associated with it. We need to keep fostering friendly on-the-air contacts. I recommend that we make sure to say something positive during each QSO. This will have a ripple effect, helping to make hamming more fun for everyone. It might even lead to your running for president of the ARRL, making it possible to break up the old-timers now running our national organization. Keep up the good work. Your magazine is an inspiration to me.

The ARRL presidency is for someone who has a need to feel important. It's a figurehead job I haven't time for, but thanks for the kind words and the thought. I really like your idea of being positive on the air. But then ham camaraderie still lives in many parts of our country where hams gather to help a fellow ham put up his tower. I just wish I'd get more good pictures of things like that . . . Wayne

Richard Mollentine WAØKKC Wayne, there seems to be a "new breed of hams." They argue, cuss (those four-letter words) on the ham bands and are determined to start an argument over anything, not an adult discussion. Surely ham radio wasn't planned and licensed for that kind of stuff.

Unfortunately, the FCC has not included a sanity section in the license tests, so we have our crazies. I'm open to any creative suggestions from readers on how we should handle nasty hams, and I've run into my share of them. This seems to increasingly be a challenge for us. And the solution is up to us, not the FCC. Are we "self-policing," as we keep bragging? Well, that's up to you. In coming up with creative approaches to things like this, keep in mind that the angry person is expressing a deeply felt inferiority and is overcompensating by putting people down as a way to build himself up. Let's not set out to really get even with these sickos . . . like sending perfumed letters to him at home thanking him for making your visit to his town so memorable and signing it with a woman's name. That might require some explaining to his long-suffering wife. Tsk. If you have a phone ROM, you could send letters to his neighbors asking them to tell him to cut out the nastiness over the air. Now, put on what's left of your thinking cap after the mice and moths have had at it all these years, and let's see what you can come up with . . . Wayne

QRX . . .

TNX

Wayne Green and all the staff of *73 Amateur Radio Today* want to extend our deepest gratitude to all our writers, advertisers, past and present employees, and, most especially, *you*, our readers. It's been a great 35 years! May we all be together for 35 more.

An International Adventure

This piece from Rajiv Dewan AA2UI. I recently installed an HF rig in my car and rediscovered the joys of HF mobiling. It was a rainy day when I left for work around 8 am on Tuesday last. I backed out of the garage, stopped and installed the three-foot whip on the Hamstick. The antenna with the whip is too tall for the garage. Serious QRM greeted me as I settled in the car seat and turned on the radio. My mobile rig is a Kenwood TS-50s that is mounted in the passenger seat well of a Saturn sedan. It is mounted to the side of the gear shift console so the radio faces up and is easily seen. The controls are within easy reach. Its power cord goes directly to the battery, with both leads fused. The antenna is a 30m Hamstick mounted to the tow hitch at the back of the car. I am most pleased about my keying arrangement. The paddles are tiny brass ones, called Einbau Wabbler, which are imported from Germany by Electro Switch of Atlanta. The paddles are mounted on a small die-cast aluminum box containing the CMOS Super II memory, keyer, and keyer batteries. The whole keyer and paddle assembly is mounted on a 'C' shaped leg clamp from a WWII J45 key used by aviators. I attach the clamp to my leg just above the knee so that the paddles are near where my right hand rests near the gear shift lever. The setup makes it quite easy to send without ever having to look at the paddles and keyer assembly. It is just as effortless as holding down the PTT switch of a microphone.

Back to the rainy day. I was on a street about half a mile from a highway entrance ramp when I caught the fragment of a QSO: "JOE QTH CHIBA." The QTH sounded exotic and the signal had a watery, over-the-pole flutter DX quality to it. It was JA1LZR in QSO with a W1. When Joe finished his QSO I quickly reached down and sent AA2UI/M twice. A roar of WI and W4 calls greeted me as soon as I stopped transmitting. I was not the only one calling him. Much to my surprise, I broke through the pileup. It must be the 5 dB/M advantage. I was merging with the traffic on the highway as Joe came back to me. I needed to shift from fourth to the fifth gear before I got back to Joe or I would not be able to hear him amid the engine scream. Fortunately, the pileup wasn't impatient and no one took advantage of the slight delay. I merged into the center lane and started my QSO. Joe's signal was quite strong and so I assumed that I would be getting in quite well into Chiba, which is on Tokyo Bay, just east of Tokyo. Joe came back with a strong signal that provided clean copy despite the QRM. He was putting 400 watts into an inverted vee and it was enough to communicate despite my compromise mobile antenna made of spirals of wire wound on a fiberglass rod and a steel whip. Joe's signal began to fade as I went down the exit ramp and was almost lost as I turned on to the surface street. I thanked Joe for the QSO and signed. Little did Joe know that I was thanking him not just for the QSO, but also for starting my day off with a bang—a DX QSO. It sure beat listening to traffic complaints on the local 2m machine! *Reprinted from the North Shore Radio Club* Transmitter.

French Fry Fox Hunting?

I've been goofy about fox hunting, whether hunter or huntee, since before they invented sunspots. I was once in a club that ran a fox hunt every Sunday, rain or shine, on 10 meters. They started with transmitters hidden in bushes, but soon progressed to the ridiculous. Like "mag mounting" a transmitter to the side of a bus. The guy who did that was forbidden from ever again hiding the transmitter. Another member got his muscle-bound, six-foot two, brother to park in a car with the transmitter and snarl at anyone who approached.

One incident sticks in my mind as sneaky even by that club's standards. A technically adept brother built a transmitter only an inch or two on a side—the first transistorized transmitter I'd seen that would fit inside a bag of french fries. He concealed the antenna by threading it through a long fry that stuck out of the package. He selected me to talk into the transmitter, so I enlisted an actor friend to provide me with a disguise. After an hour of preparation, I took a seat in a local fast-food emporium.

Soon the hunters appeared outside. They circled the restaurant for some time, aiming their directional loops this way and that. Finally one of them got up the nerve to bring his equipment inside. Instantly, the manager rushed out and asked if they were a bomb squad. After convincing him they were only deranged hams, they searched the dining area. They were on their way back outside when they passed near me—just as little girl at the next table shouted, "Daddy, why is that man talking to his french fries?"

TNX to Jim Reed KD3S via Maryland Radio Center, Indiana County ARA's The Sine of the Times, *and the ARNS* Bulletin.

Astronomer Joins Alien Search

The director of the Ohio State University Radio Observatory has been appointed a technical advisor to The SETI League, Inc., in the Search for Extra-Terrestrial Intelligence. Ohio State professor Dr. Robert S. Dixon's considerable expertise will help the organization to privatize research once conducted by NASA.

The Ohio State radiotelescope, affectionately known as Big Ear, was home to a mysterious microwave signal detected on August 15, 1977. Known thereafter as the "Wow!" signal (after a single word scribbled in the margin of the computer printout by researcher Jerry Ehman), it exhibited all of the expected characteristics of a coherent signal of intelligent extraterrestrial origin. Scientists consider the "Wow!" signal to be the best evidence to date of the existence of other technologically advanced civilizations in the cosmos. Although it has stood up to eighteen years of scrutiny, it has never reappeared. Dixon and his SETI League colleagues hope to detect additional "Wow!"-type signals.

SETI seeks to determine through scientific measurements whether humankind is alone in the universe. Congress terminated all of NASA's SETI funding in late 1993. Experimenters interested in participating in a privatized search, or citizens wishing to help support it, should contact The SETI League, Inc., membership hotline at 1(800) TAU-SETI. The SETI League, Inc., is a membership-supported, nonprofit educational and scientific corporation dedicated to the electromagnetic Search for Extra-Terrestrial Intelligence.

ARRL President Resigns

George Wilson W4OYI, 63, who was incapacitated by a stroke last February and is still in the hospital recuperating, resigned in July as the ARRL president. Filling his place until the end of his term in January is Rodney Stafford KB6ZV of San Jose. Rod is now a Santa Clara County municipal judge, after lawyering for 18 years.

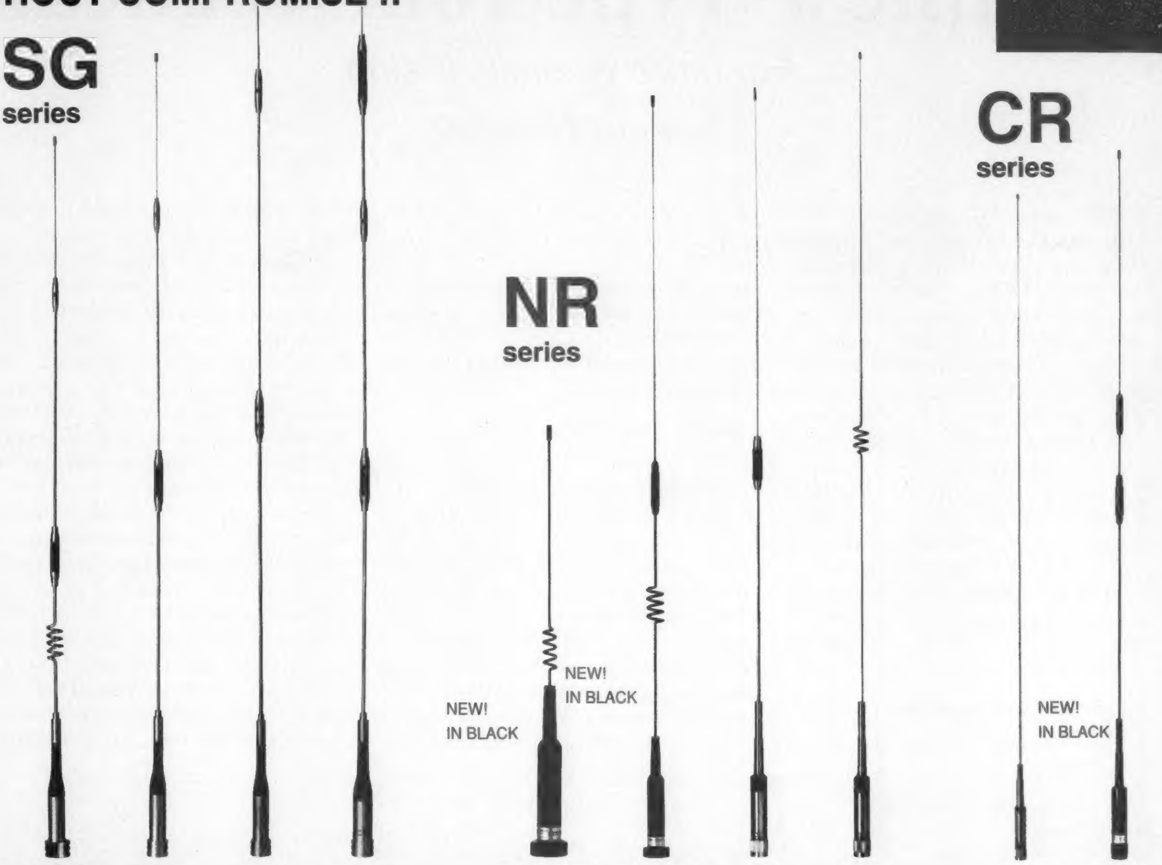
The Certificate of Proclamation by the mayor of Englewood, NJ.

Englewood Proclamation

The mayor of Englewood, New Jersey, has issued an Englewood Amateur Radio Association Week proclamation for the 34th consecutive year to celebrate the club's outstanding Field Day activity, where they've won first place in their transmitter category for 30 of the last 32 years.

DIAMOND'S STATE OF THE ART VHF / UHF MOBILE ANTENNAS – MAXIMUM PERFORMANCE WITHOUT COMPROMISE !!

DIAMOND ANTENNA

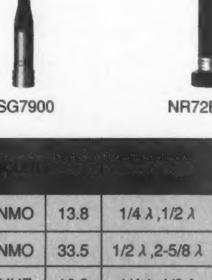


NR-72BNMO	2m/70cm	2.15	100	NMO	13.8	1/4 λ ,1/2 λ
NR-73BNMO	2m/70cm	2.15/5.3	100	NMO	33.5	1/2 λ ,2-5/8 λ
NR-770SA	2m/70cm	2.15/2.15	100	UHF	16.9	1/4 λ ,1/2 λ
NR-770HA	2m/70cm	3.0/5.5	200	UHF	40.2	1/2 λ ,2-5/8 λ
NR-770HNMO	2m/70cm	3.0/5.5	200	NMO	38.2	1/2 λ ,2-5/8 λ
NR-770RA	2m/70cm	3.0/5.5	200	UHF	38.6	1/2 λ ,2-5/8 λ
NR-790A	2m/70cm	4.5/7.2	120	UHF	57.5	6/8 λ ,3-5/8 λ
SG-7000	2m/70cm	2.15/3.8	100	UHF	18.5	1/4 λ ,6/8 λ
SG-7200NMO	2m/70cm	3.2/5.7	150	NMO	36.6	1/2 λ ,2-5/8 λ
SG-7500A	2m/70cm	3.5/6.0	150	UHF	40.6	1/2 λ ,2-5/8 λ

SG-7900	2m/70cm	5.0/7.6	150	UHF	62.2	7/8 λ ,3-5/8 λ
SG-2000	2m	5.2	150	UHF	62.6	7/8 λ
NR-140A	1-1/4m	3.8	100	UHF	36.2	5/8 λ
NR-124	23cm	8.4	100	N	25	4-5/8 λ
CR-214S	2m/1-1/4m	2.15/3.4	120	UHF	37	1/2 λ ,5/8 λ
CR-224A	2m/1-1/4m	5.0/6.0	150	UHF	68.5	7/8 λ ,2-5/8 λ
CR-320A	2m/1-1/4m/ 70cm	2.15/3.8/5.5	200/ 200/100	UHF	37.4	1/4 λ ,1/2 λ , 2-5/8 λ
NR-2000NA	2m/70cm/ 23cm	3.15/6.3/9.7	100	N	39	1/2 λ ,2-5/8 λ , 5-5/8 λ

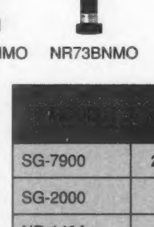
SPECIAL FEATURES

- Factory pre-tuned /no adjustment
- Highest Performance antennas
- SG&NR series do not need grounding
- NMO and UHF (PO) base styles
- New black color models available
- Fold-over feature on most models



FOLD-OVER

PATENTED ONE-TOUCH FOLD-OVER FEATURE



RF PARTS
SAN MARCOS,CALIF.
(619) 744-0900

Simple J-Type 10m Vertical

For more versatile DXing.

by John C. Reed W6IOJ

The main advantage the vertical HF antenna has over its horizontal counterparts is its low-angle radiation pattern. This is important on 10 meters, where success often requires low-angle radiation propagation. Another advantage of the vertical antenna is its unobtrusive profile. You can use it in locations, such as on a city lot, where many other antennas would not fit, or would be considered an eyesore by the neighbors.

The main negative feature of verticals is that ground path radiation is dominantly vertically polarized, making this type of antenna sensitive to interference from such sources as automotive ignition noise. If, however, your environment is fairly noise-free, as is mine, then the vertical may just be for you!

Entry-Level Construction

This is a simple antenna project any do-it-yourselfer can put together. All the parts are available from Radio Shack and your local hardware store. The assembly includes an easy-build balun-matching transformer. Also described is a simple SWR directional coupler so that you can accurately match the antenna to a 50-ohm feedline.

10m "J" Overview

The diagram in Figure 1 shows the configuration and lists the materials. The 1/2-wave radiator is a 1/4-wave whip antenna connected to a 1/4-wave wire inside a plastic PVC pipe. The wire end of this 1/2-wave assembly is matched to a 50-ohm transmission line with an open wire 1/4-wave stub with a balanced to unbalanced balun. In the normal J-type antenna the 1/4-wave stub is part of the vertical structure. My antenna worked well with the stub close to perpendicular to the ground; you may want to experiment with this angle for best results.

As indicated in Figure 1, the stub wires are spaced 1 1/2" with plastic spacers at 1-foot intervals. Although I used glass epoxy for the spacers (etched PCB), Plexiglas (TM) works just as well. Drill the spacers with wire clearance holes at each end, temporarily hold them in position with small pieces of masking tape, and then fasten them with a spot of all-purpose adhesive.

Figure 2 depicts the simple method of mounting the whip antenna in the plastic pipe. Although I used glass epoxy for the indicated plastic washers, you can use any hard plastic.

The balun transformer detailed in Figure 3 converts the single-ended, 50-ohm transmission line to a balanced 200-ohm output for interfacing with the 1/4-wave antenna stub. The transformer consists of

A) 8ft 6in whip antenna (RS 21-903).
B) End coupling (see Figure 2 for details).
C) 8-ft.3/4 in plastic pipe (PVC 1120 PR200-200 PSI).
D) 6-ft. 1-in x 2-in wooden dowel, which supports for plastic pipe).
E) 2" wide duct tape, which fastens pipe to wood support.
F) 2" x 2" wooden dowel.
G) Stub and interface. 1 3/4" x 1/2" x 1/16" glass epoxy with copper stripped from PCB (RS 276-1591). Center tied to the 3/4" plastic pipe.
H) 9-ft. open wire 1/4-wave stub, #18 wire (solid hookup wire, insulation stripped off (RS 278-1291)). Wires spaced 1 1/2" with glass-epoxy spacers every 12."
I) Stub/cable balun. (See Figure 3 for details.) Connected to stub about 7 ft. 9" from open stub end (adjustable).
J) Shorting bar, about 8 ft. 8in from open stub end (adjustable).
K) Glass epoxy stub tie down.
L) 50-ohm feedline (RG-58U, RS 278-1326).
M) Highest house roof elevation.

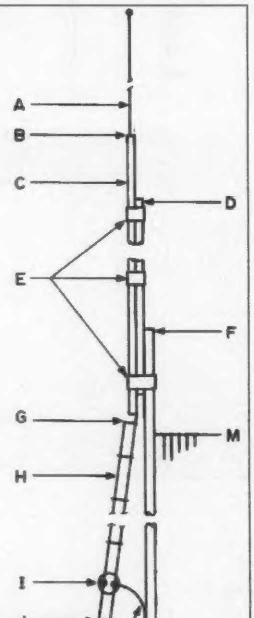


Figure 1. Antenna Schematic.

A) Whip antenna.
B) Whip antenna clamp made from sheet aluminum.
C) 1 1/8" x 1/16" plastic washer,center clearance hole for the whip (foil stripped PBC).
D) 1/4" thick spacer, several layers of plastic tape.
E) 7/8" x 1/16" plastic washer, clearance hole for whip.
F) Plastic tape to prevent the washer from sliding down.
G) 3/4" PVC pipe.
H) 7/8" x 1/16" plastic washer, clearance hole for the whip antenna mounting screw.
I) Washer/soldering lug.
J) Whip antenna hold-down nut.
K) ##18 wire solid hookup (RS 278-1291).

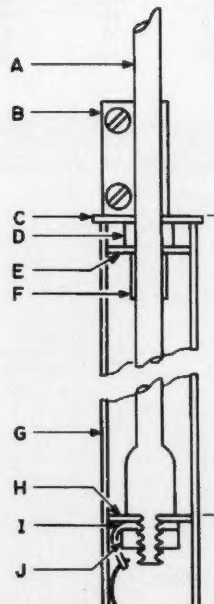
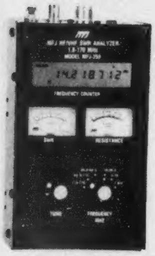


Figure 2. Whip antenna-PVC pipe interface detail.

MFJ HF/VHF SWR Analyzer™

. . . Read your antenna SWR from 1.8 to 170 MHz . . . built-in 10 digit LCD frequency counter. . . RF Resistance Meter™. . . smooth vernier tuning . . .



MFJ-259 **$229^{95}**

MFJ-259 handheld *Univeral SWR Analyzer™* lets you read your antenna SWR from 1.8 to 170 MHz quickly and easily without any other equipment!

MFJ's exclusive *RF Resistance Meter™* lets you measure RF resistance up to 500 ohms at minimum SWR.

Has built-in 10 digit LCD frequency counter and smooth vernier tuning.

You get *four* instruments in one . . . 10-digit frequency counter . . . RF signal generator. . . SWR Analyzer™. . . *RF Resistance Meter™*

Measure antenna resonant frequencies and 2:1 SWR bandwidths. Adjust mobile antennas, antenna tuners and matching networks in seconds.

Measure RF resistance, inductance, capacitance, resonant frequency of tuned circuits, transmission line velocity factor /impedance/ loss. Test RF chokes,baluns.

MFJ-209, $109.95, same as MFJ-259 less frequency counter and *RF Resistance Meter™*

See *free* MFJ catalog for complete line of MFJ SWR Analyzers™.

MFJ-949E 300 W Tuner

MFJ-949E **$139^{95}**

World's most popular antenna tuner covers 1.8-30 MHz, has lighted *peak/* average Cross- Needle SWR/ wattmeter, 4:1 balun for balanced lines and *full size* 300 watt dummy load.

Versatile 8 position antenna switch lets you *pre-tune* MFJ-949E into dummy load to minimize QRM.

Custom inductor switch was carefully engineered to withstand extreme voltages and currents.

Cabinet is chemically etched to MFJ's bond tough *baked-on* paint.

VHF/HF Packet TNCs

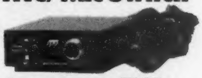
MFJ-1270C **$119^{95}**

MFJ-1270C *super* TAPR TNC clone has a world wide reputation as *the most reliable packet TNC in the world* -- many work 24 hours a day for years without a single failure!

Fully TAPR TNC-2 compatible, VHF *and* HF operation, *free* AC power supply, new *enchanced* mailbox expandable to 512K with auto/reverse mail forwarding, WeFAX mode lets you print weather maps, optional plug-in 2400/9600 baud modems, KISS interface, ***now GPS compatible.***

MFJ TNC/Mic Switch

MFJ-1272B **$39^{95}**



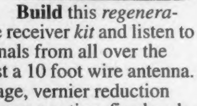
Switch between your TNC or microphone by pushing a button!

Just plug pre-wired cables into your rig's mic connector and TNC.

Plug-in jumpers let you use nearly any rig with 8 pin mic connector.
MFJ-1272B/MFJ/TAPR TNC2 clones; MFJ-1272BX/PK-232; MFJ-1272BYV/KAM VHF/KPC3; MFJ-1272BYH/KAM HF Port; MFJ-1272BZ/PK-88, $39.95 each. *For 8 pin RJ45 modular phone jack replace B with M in model number above.*

Regenerative RCVR Kit

MFJ-8100K **$59^{95}** *kit*
MFJ-8100W **$79^{95}** *wired*



Build this *regenerative* shortwave receiver *kit* and listen to shortwave signals from all over the world with just a 10 foot wire antenna.

Has RF stage, vernier reduction drive, smooth regeneration, five bands.

MFJ-1278B Multi-Mode Data Controller

MFJ-1278B **$299^{95}**

Use this MFJ-1278B, your transceiver and computer to transmit and receive digital communications! You'll discover a whole new world of ham radio and communicate in ways you never knew existed on our ham bands.

The *world class* MFJ-1278B Multi-Mode and MultiCom™ software is packed with features *no other* multi-mode gives you.

You get *10 digital modes* . . . Packet, AMTOR, PACTOR (at no extra cost), RTTY, ASCII, Navtex, Color SSTV, 16 Gray Level FAX, CW and Memory Keyer plus an *enchanced* 32K Mailbox.

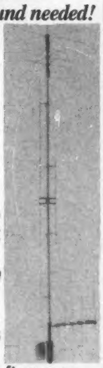
You'll have fun joining worldwide *packet* networks and exchanging *color SSTV* pictures with your buddies around the world. You'll marvel at *full color FAX* news photos as they come to life on your screen. You'll see weather changes on highy detailed *weather maps* in all 16 gray levels. You'll eavesdrop on late breaking news as it happens on *RTTY*. You'll enjoy error free HF QSOs on *PACTOR* and *AMTOR* and receiving packet mail in an *enchanced 32K mailbox*. Want to copy some *CW*? Just watch your screen.

MFJ-1289, $59.95, MultiCom™ software and cables.

MFJ halfwave vertical Antenna

6 bands: 40, 20, 15, 10, 6, 2 Meters . . . No radials or ground needed!

MFJ-1796 **$199^{95}**



Operate 6 bands -- 40, 20, 15, 10, 6 and 2 Meters --with this MFJ-1796 *ground independent* halfwave vertical antenna! No radials or ground ever needed!

It's only 12 feet high and has a *tiny* 24 inch footprint! You can mount it anywhere from ground level to the top of a tower -- on apartments, condos, small lots, even on motorhomes. Perfect for vacations, field day, DX- pedition, camping.

Frequency selection is fully automatic -- all you do is transmit. Its *low angle of radiation* really reachs out and brings in DX. Omni-directional. 1500 watts PEP.

Efficient *end loading*, no lossy traps. *Entire length* is always radiating. *Full size* halfwave on 2 and 6 Meters. High power *air-wound* choke balun eliminates feedline radiation. Adjusting one band has minimum effect on other bands. Add $20 s/h.

Easy to assemble -- you'll have it on the air in an afternoon.

MFJ's world famous 3 KW Versa Tuner V

MFJ-989C **$349^{95}**

Here's why the MFJ-989C is the finest 3 KW antenna tuner money can buy . . .

Two *massive* 250 pf transmitting variable capacitors can handle *amps* of RF current and *6000* RF volts. Logging scales.

Precision ball bearing roller inductor, three digit turns counter and spinner knob give you exact inductance control for minimum SWR.

Lighted *peak/*average Cross-Needle SWR/Wattmeter has 200/2000 watt ranges. Super heavy duty *current* balun has two giant $2^1/_2$ inch powder iron toroid cores wound with *Teflon®* wire.

Six position *ceramic* antenna switch has extra large contacts. Flip stand, dummy load, one year *unconditional* guarantee, aluminum cabinet, tough *baked-on* paint, locking compound on nuts/bolts, handles 3 KW PEP, $10^1/_8$x$4^1/_2$x15 in. Meter lamp needs 12 volts. Add $13 s/h.

MFJ *No Matter What™* Guarantee

MFJ's famous one year *No Matter What™ unconditional* guarantee means we will repair or replace (at our option) your MFJ product sold in this ad *no matter what* for a full year.

Super Hi-Q Loop Antenna

MFJ-1786 **$299^{95}**

Tiny 36 inch diameter high efficiency loop antenna covers 10-30 MHz *continuously* with low SWR. Handles 150 watts.

Ideal for home installations where space is limited-- apartments, condos, small lots. Take on trips.

All welded construction.

Remote control has *Automatic Band Selection™*, Cross-Needle SWR/ Wattmeter. No control cable needed. Use batteries or 110 VAC. Add$20 s/h.

No ground or tuner needed.

MFJ-1782, $269.95, like MFJ-1786 but remote control has only slow/fast tune buttons.

Dual Band Mobile Ant.

Mobile Antenna for 144/440 MHz

MFJ-1724B **$14^{95}**

MFJ *dual band* magnet mount mobile antenna for 144/440 MHz has 19 inch stainless steel radiator, low SWR. For mobile rigs with SO-239 UHF connector *and* handie-talkies with *included* BNC adapter.

5/8 Wave Mobile Ant.

MFJ-1728B **$24^{95}**

Maximum Gain™ 5/8 Wave 2 Meter *magnet mount* mobile antenna has stainless steel radiator, 12 ft coax, low SWR.For mobile rigs with SO-239 UHF connector *and* handie-talkies with *included* BNC adapter.

5/8 Wave Ground Plane

MFJ-1750 **$19^{95}**

$19.95 gets you a 2 Meter 5/8 wave ground plane *home station* antenna! You get the highest gain of any single element antenna, shunt fed matching, ceramic insulators.

MFJ-1752, $19.95, for 220 MHz.

Free MFJ Catalog

Write or call . . . 800-647-1800

Nearest Dealer/Orders: 800-647-1800
Technical Help: 800-647-TECH (8324)

• 1 year ***unconditional*** **guarantee** • 30 day money back guarantee (less s/h) on orders from MFJ • **Free catalog**

MFJ MFJ ENTERPRISES, INC.
Box 494, Miss. State, MS 39762
(601) 323-5869; 8-4:30 CST, Mon-Fri.
FAX: (601)323-6551; **Add $6 s/h**

MFJ . . . making quality affordable

CIRCLE 86 ON READER SERVICE CARD

a bi-filar six-turn coil wound on a 1-1/16" diameter form (3/4" PVC). The wire used is #18 solid hook-up wire (RS 278-1291).

The J Measures Up

Line type performance results from the distributed capacitance between the two wires, making a relatively wide bandpass transformer. Performance was measured using a 50-ohm source together with a 200-ohm resistive load. Although the results indicated the response is less than -0.5 dB at 14 MHz, it falls off much faster at the high frequencies. At 146 MHz, it's about -20 dB (an advantage when working RS-11).

To measure insertion loss, I connected two transformers in series (50-200-200-50-ohm), and measured the response with and without the transformers. The difference was about 0.1 dB. This is trivial when considering radiation loss, but there is still significant thermal (heating) losses while running high power. In the final antenna configuration, with 100 watts into the antenna, element heating is just barely apparent to the touch.

You can double the wattage capability by simply paralleling two transformers.

Correction Factors for Selected Diodes

Vp In	Vp Out	Factor
5.0	4.88	1.02
4.0	3.90	1.03
3.0	2.87	1.04
2.0	1.89	1.06
1.0	0.92	1.09
0.8	0.72	1.11
0.6	0.52	1.15
0.5	0.43	1.16
0.4	0.33	1.21
0.3	0.24	1.25
0.2	0.15	1.33
0.1	0.06	1.67
0.05	0.02	2.5

My tests of this configuration show near identical results at 28 MHz, but the frequency response becomes sharper—about -1 dB—at 14 MHz. When fabricating the transformer, you must hold the wires close together to achieve the desired distributed capacitance between wires. Do this by making the form length the same as the bi-filar coil width, and strapping the two together.

For the strapping I used two pieces of masking tape about 1/4" wide. I wrapped them through the form center and around the wire, then coated the masking tape with an all-purpose adhesive (RS 642307). In forming the coil, first wind the wire on a mandrel smaller than the actual form to make certain the wire has a snug fit when placed on the final form.

Directional Coupler

This antenna, which is essentially an end-fed wire dipole, has a significant Q (about 13). Since the 10m band is so wide (28–29.7 MHz), a high-Q antenna there will give high SWR values at the band edges, so it's important to accurately trim the 1/4-wave stub length (shorting bar position), and adjust the balun connecting position for minimum SWR. You can do this easily by using a simple home-made directional coupler.

The directional coupler detailed in Figure 4 uses glue-down 1/8" wide PCB

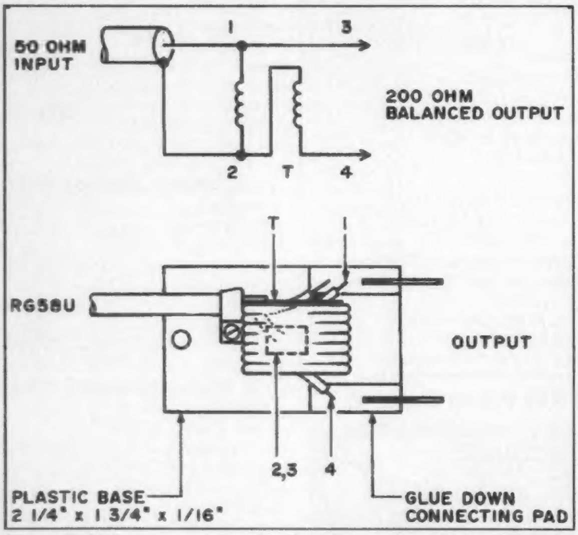


Figure 3. Balun construction details. (The numbers 1–4 and T in the schematic correspond to those in the lower diagram, which shows the balun's physical layout.)

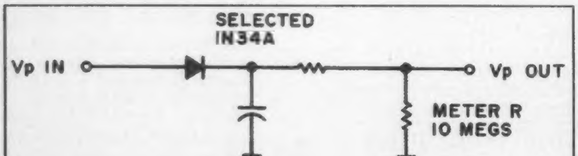
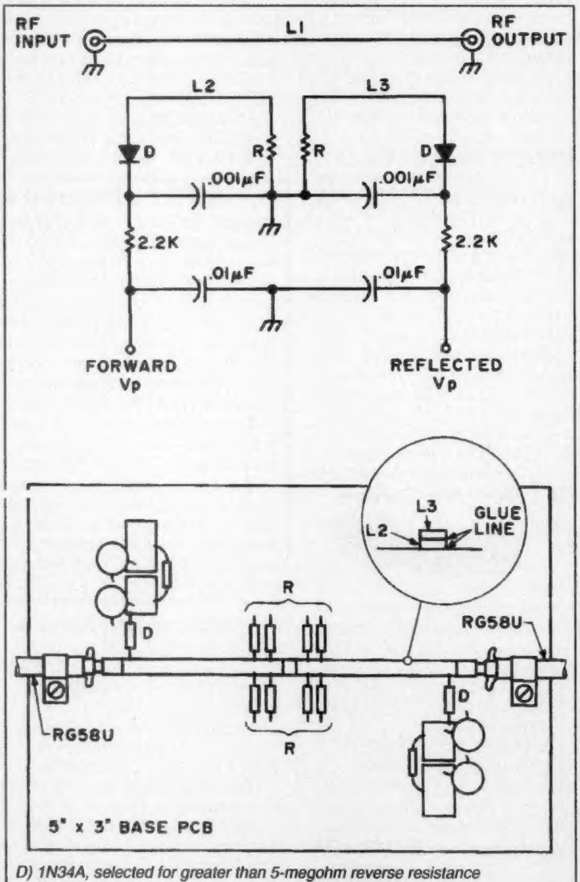


Figure 5. Correction factors for selected diodes, which are those having a reverse resistance of greater than 5 megohms.



D) 1N34A, selected for greater than 5-megohm reverse resistance (RS 276–1123).
L1) 3 1/2" x 1/8" x 1/16" glass epoxy PCB, either single- or double-sided copper (RS 276-1591). Glue to base PCB with adhesive (RS 64-2307).
L2) 1-1/4" x 1/8" x 1/16" glass epoxy PCB, either single- or double-sided copper. Glue to top of L1.
L3) Same as L2; leave about 1/32" spacing between ends of L2 and L3.
R) Select for minimum reflected power. About 36 ohms (100-100-150-1k in parallel).

Figure 4. Directional coupler.

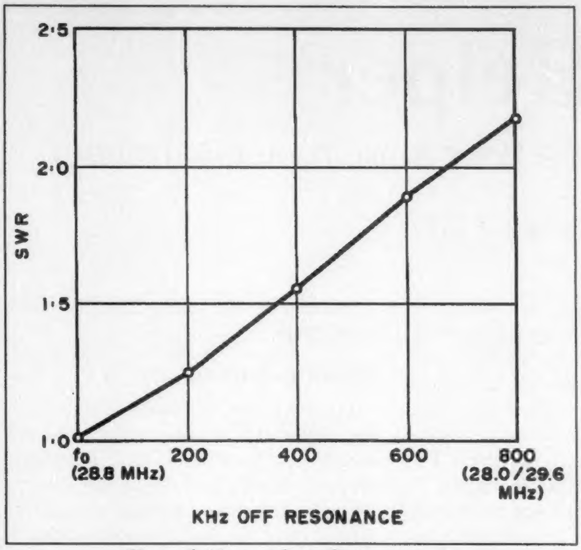


Figure 6. Measured standing wave ratio.

strips. Directional current is detected with short strips glued to the top of a transmission stripline. Resistor terminations on these coupled strips cancel the effective coupled output in one direction. These terminations are trimmed for minimum SWR indication with 20-watt or more input into the directional coupler and loaded with a 50-ohm dummy load. My dummy is 20 1k 1/2-watt resistors in parallel, immersed in a pint of cooking oil.

The termination resistor is actually four 1/4-watt resistors in parallel, which lets you select various resistor values to establish minimum reflection indication. My assembly uses 100-100-150-1k-ohm resistors. This value will be different for different assemblies, depending upon the PC thickness and dielectric constant. When aligned, and with 20-watt input, the coupler output should read about 2 Vp in the forward direction and less than 0.1 Vp in the reflected direction (SWR = V(fwd) + V(ref)/V(fwd) - V(ref)). 1N34A diodes with a reverse resistance of 5 megohm or greater give reliable Vp readings up to less than 0.1. Correction factors for the low voltage readings are indicated in Figure 5. (Since sensitivity is directly proportional to frequency, this directional coupler works well in the VHF/UHF frequency range.)

Alignment is simple when using the directional coupler. Simply slide the shorting bar and the balun connecting position for minimum reflected Vp. The adjustments are rather critical, but it is not too hard to obtain an SWR of less than 1:1. The final measurement results are shown in Figure 6.

Cover More Angles

I compared the vertical antenna performance with that of my horizontal antenna using a coax relay to switch quickly between the two. My horizontal antenna is a center-fed long wire with dominant nodes in specific directions (66 feet long).

The antennas complemented each other very well. As mentioned above, the vertical tended to perform better on low-angle skip; the horizontal on high-angle skip. It was also handy to be able to switch between the two to find a better S/N ratio, depending on whether vertically or horizontally polarized ambient noise dominated.

For little money and a few hours of home-brewing, I improved my DXing considerably!

Tuner Helper

An easier (and safer) way to tune your antenna while driving.

by F. Dale Williams K3PUR

You are probably familiar with Tuna Helper and Hamburger Helper to make meal preparation easier; this Tuner Helper is meant to assist you in adjusting the antenna tuner or the matching network (depending on fixed or mobile installation) without using the transmitter. This project originated from my need to be able to tune an all-band, motor-driven mobile antenna while driving, without having to activate the transmitter and tune the antenna matching network while watching the SWR/power meter for the best operating point.

Most modern transceivers either come with built-in antenna tuners or are available as separate units. If your station is blessed with matched antennas for each band, you obviously don't need a tuner. Similarly, if your installation has a separate remote variable matching network at the antenna, an extra antenna tuner not only is unnecessary but also creates havoc in the tune-up process since both ends of the transmission line now have frequency-dependent complex variables. Since the all-band mobile antenna can be tuned to 50 ohms at any HF frequency from the driver's seat by a toggle switch, it doesn't require any additional matching networks. The Tuner Helper radiates an RF signal in one of five bands, from approximately 3.5 to 30 MHz. Since the selected band is continuously swept in frequency from low to high, the only tuning required is to the antenna, or tuner in a single- or multiband antenna installation, while monitoring the strength of the tone demodulated at the selected receiver frequency. Once the antenna or tuner is adjusted to produce the strongest response at the receiver frequency selected, the system has found the best possible match. Then you can power off the Tuner Helper and begin operating without a lot of transmitter tuning steps requiring you to take your eyes off the road while trying different matching combinations and adding another carrier to the ether.

Circuit Description

Figure 1, the schematic diagram of the Tuner Helper, is divided into the sweep generator and swept oscillator sections. Looking at the sweep generator section first, you can see that the requirements are for a linear sawtooth waveform—that is, with constant rise and sharp falloff, from close to zero volts or ground to over 6 volts. Since the MV1404 capacitive diode has a very low ratio of capacitance change to voltage at the high voltage end of the performance curve, a large increase of voltage (that is, 6 to 9 volts) yields a very small increase in frequency, especially in the lower bands. Transistor Q1 acts as a constant current generator, charging capacitor C1 at a rate determined by the value of R1. The high input impedance of U1b insures that the constant current generator is not excessively loaded and

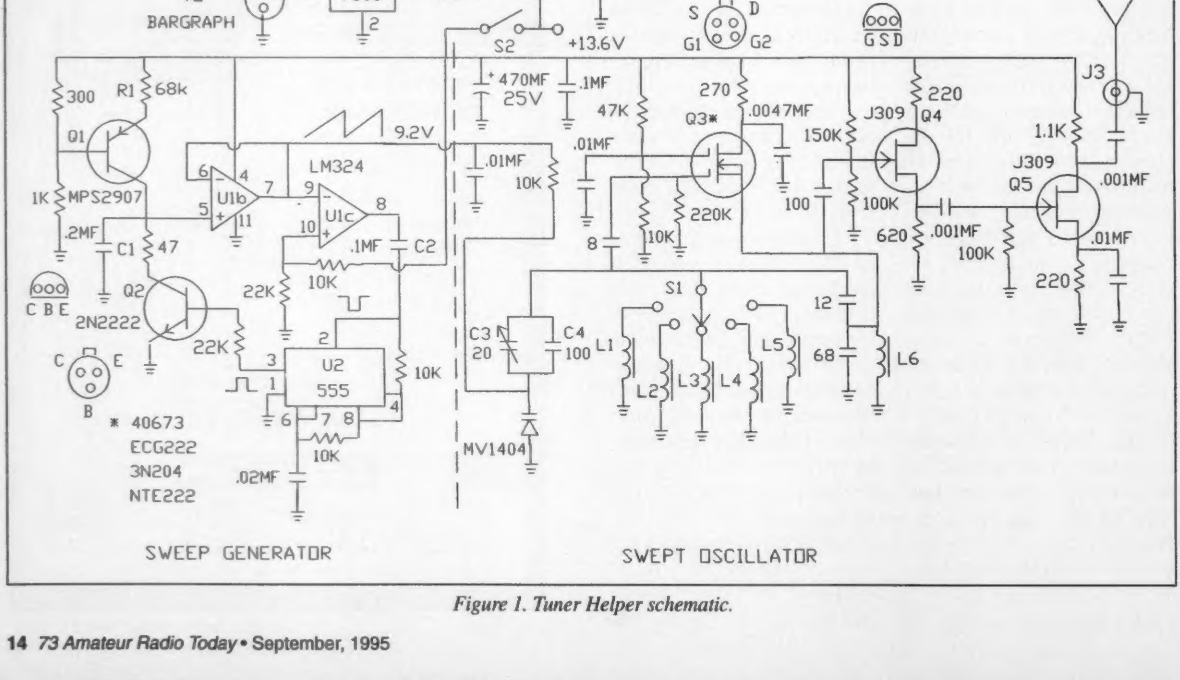


Figure 1. Tuner Helper schematic.

J-Pole in your Pocket?

Tough dual-band antenna for the travelin' man or the condo dweller. Hang-anywhere style and extra range can save life in an emergency.

James H. Gray W1XU

During my years of traveling around the eastern United States on business or vacation, I often wished I had a small, inexpensive and easy-to-use antenna to match my little handheld 2 meter radio. Occasionally I had an HF rig in the car, but more often it was the little 2 meter radio which was useful and fun. On long road trips it alleviated boredom, kept me awake and almost always assisted me to find a motel, restaurant, or other ham's QTH. On such trips the mobile antenna was fine until I needed more range from the motel.

When I traveled by plane, the rig was the handheld with no amplifier. It had only a small telescoping whip that I could extend to about 19 inches. If I happened to be close enough to a repeater in a large city, that was fine and I managed to "work" the locals in spite of low power and a minimal antenna.

But there were occasions when there was no local repeater, or when I was inside a steel-and-concrete building. At such times I wasn't able to make any contacts at all and had to resort to dull tedious television programs before going to bed.

If you face similar problems when traveling light and by air, you know how it feels to be alone among the many.

The Pico Solution

Today, the travelin' man has a ready solution to the problem: a neat antenna produced by Antennas West and called the "Pico-J." It meets all the requirements set forth in the first sentence. Pico means "small," as in "picofarad," and "J" stands for "J-pole," the well-known low-angle, omnidirectional vertically polarized antenna—just what's needed for 2 meters.

Antennas West's Pico-J offers some features not found in the usual J-pole. For example, the feedpoint is already found and matched for you, and the antenna is small and light—so much so that it can be rolled up and slipped into a small eyeglasses case. It looks like a sleek black ribbon 55 inches long. A six-foot small-diameter coax feedline comes off the bottom. Its gold-pin BNC attaches directly to your radio.

PASS THIS TEST!
WIN $5
Clip this ad and circle the TigerTail™. Send it with your order to get $5 off any purchase.

A small loop at the top may be slipped over a curtain rod or a nail or any other suitable projection. But, if by chance you don't happen to find a suitable support, Antennas West thoughtfully provides a small suction cup with an embedded hook that can be slapped up on a window or any smooth surface, and presto!—you're on the air!

Pico-J is completely weather-sealed and could be hung outdoors if you wish. Otherwise, you can hang it in a closet or a doorway; in fact, anywhere that is convenient and where your signal won't be blocked. The extra reach provided by this beauty could save life in an emergency, and is always useful when just plain chatting with the locals.

Your Pico-J stretches range, improves reception, reaches far-away repeaters, and saves your battery pack.

The measured VWSR is less than 2:1 between 142 and 150 MHz—ideal for CAP, MARS, and other services near the 2 meter band—and is a very beautiful 1:1 at 146 MHz. Not bad, eh?

Best of all, considering the benefits, is the price: $19.95 for the 2 meter model, $26 for the 2m/70cm dual bander, both complete with the soft vinyl case to store your Pico-J when it's not in use.

On a recent trip I tucked Pico-J into my briefcase, right next to the handheld. No, I didn't even use the "duckie" or the telescoping whip because I had all I needed in this one neat antenna. Maybe you'll find the same.

*–condensed from **RadioFun***

Can You Find theTiger'sTail?

If your eyes are sharp you can spot the **TigerTail**™ in the photo above. It's not attached to something that bites; instead it puts extra growl into the signal from the HT it's attached to.

TigerTail™ improves SWR, lowers radiation angle, and extends range. You can use low power and save your battery pack, but still have a big signal.

Better than an amplifier, it improves reception too. **TigerTail**™ does all this by simply slipping under your flex antenna and just hanging down— without sticking up or out or getting in the way.

No Antennas Allowed?

*Who will see **Pico-J** hanging in your closet or on the balcony? But your signal will be heard. **Pico-J's** half wave radiator is sleek and unobtrusive. his thin flexible feedline is barely noticeable. When his work is done Pico-J rolls up and slides into his pouch like the Genie slipping back into the bottle.*

*Carry **Pico-J** on hikes or trips as you would carry a pair of glasses. Keep him in your emergency jumpkit. When you need gain and low angle omnidirectional coverage pull out **Pico-J** and be full quieting when it counts.*

New Pico-J's for 1995

PJ Packet $22—*Maximum efficiency on 2m packet frequencies.*
PJ 220 $19.95—*Go everywhere gain for the "private" band.*
Pilot's Pico-J $39—*Aviation band range booster for pilots on the go.*

☐ **Yes, I want to increase range and save my batteries!**
___Send my Pico-J. 2m or 220=$19.95, Packet=$22, Dual=$26, Pilot=$39.
___Send my TigerTail. (1 for $7.95, 2 for $15, 3 for $21. Specify band)
___Send a combo (PJ + TT). (Just add $5 to your Pico-J order)*All prices ppd.*
☐ **Yes, I circled the TigerTail! Knock $5 off my order.**
Name________________
Call________________ Phone________________
Street________________ Unit________
City________________ State________ Zip________

Antennas West
Box 50062-S Provo UT 84605
InfoPak $1
Order Hotline **800 926 7373**

CIRCLE 57 ON READER SERVICE CARD

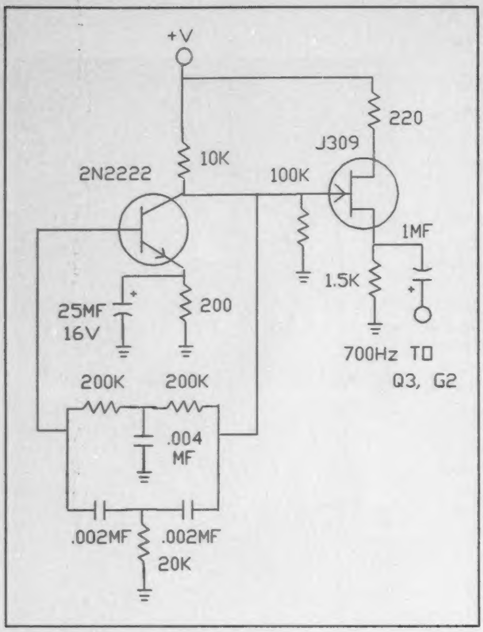


Figure 2. Tone oscillator.

forwards the voltage level of C1 to U1c. Configured as a comparator, U1c output pin 8 goes low when pin 9 rises above 9 volts. This switching action applies a trigger pulse via capacitor C2 to activate the monostable multivibrator U2. The resulting high pulse from pin 3 of U2 provides a discharge path for capacitor C1 through turned-on transistor Q2. A continuous sweep ramp with reset is produced at pin 7 of U1b at a rate determined by R1C1 (approximately 75 Hz).

The swept oscillator section consists of a dual-gate MOSFET transistor in a Colpitts configuration, followed by a buffer amplifier that provides the RF from the selected frequency range to an output amplifier and short antenna. As the output sawtooth waveform from U2, pin 7, is applied to the varactor, the capacitance of the tank circuit decreases from approximately 62 pF at the low end of the ramp to a very low value at the maximum sweep level of about 9.2 volts. The on-off switching action of the sweep waveform modulates the generated RF to produce an obnoxious buzz, which is easy to discern from other low-level signals at the selected receiver frequency when adjusting the tuner or antenna.

Those hams more interested in being able to tune manually to a specific frequency instead of sweeping a band, especially for fixed station operation, may replace the sweep generator section, C3, C4, and the varactor/biasing circuitry. A 50 pF variable capacitor across the tank circuit will allow tuning across each band. Depending on your circuit layout, the 68 pF capacitor may have to be decreased to obtain the necessary tuning range. To maintain the tone capability in the manual tuning version, you may add the twin-T oscillator shown in Figure 2. It provides a 700 Hz audio signal to gate 2 of Q3 for mixing with the generated RF.

Since the human ear can supposedly detect a change in audio level only greater than 3 dB, and a moving vehicle is not akin to an anechoic chamber, I added an additional level indicator, remotely mounted on the dashboard (no looking down at the S-meter). As shown in Figure 3, an LED bar graph and driver are connected to the receiver audio output to provide a visual, as well as audible, indication of received signal level. Since it's mounted in a small enclosure and attached to the dashboard with double-sided or hook-and-eye tape, it's easy to tune the rig without having to look down at the S-meter for the final couple of dBs.

Construction

The Tuner Helper is easily built using a pre-drilled, general-purpose circuit board with solder pads, such as the Radio Shack number 276-158. A suggested layout is shown in Figure 4. To make it more convenient for both construction and testing, the bandswitch S1 was mounted to the circuit board using a small angle bracket made from scrap aluminum. Final installation of S1 should be delayed until the five coils are successfully wound and tested. The five toroid coils are then mounted vertically and secured by silicon cement, directly behind the bandswitch. After the space required for the toroids has been defined, construct the circuit. Begin with the varactor and other components of the tank circuit, and then progress to the oscillator, buffer, and amplifier. Test this part of the circuit with each individual coil by connecting a 10k-ohm, or greater, variable resistor across a voltage source of approximately 10 volts, with the wiper temporarily attached to the sweep end of the varactor biasing resistor. By monitoring the output frequency on a frequency counter or receiver, while adjusting the biasing voltage from about 1.2 to 9.2 volts, you can check each coil for minimum frequency range. Capacitor C3 is set to bring the lowest frequency as close to 3.5 MHz as possible, with the high end reaching 6 MHz on the low band. After the swept oscillator section is completed and tested, you can construct the sweep generator. Test points for voltages and waveforms are noted in the schematic diagram.

There is plenty of room on the circuit board for layout. The size of the board makes it compatible with many small enclosures, such as the Radio Shack number 270-253, or smaller versions available from Ocean State Electronics—(800) 866-6626 (order line), or (401) 596-3080 (information). The antenna consists of a 6-inch piece of #12 or #14 solid wire soldered into an RCA male plug, with a short piece of insula-

Continued on page 18

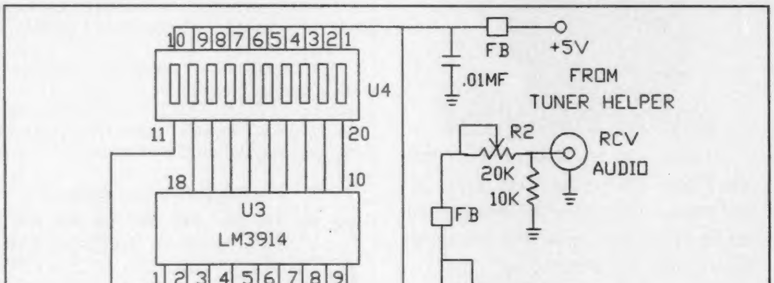


Figure 3. Bar graph schematic.

Place
Stamp
Here

73 Amateur Radio Today

PO BOX 7693
RIVERTON NJ 08077-8793

FEEDBACK

In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers, which appear on each article/column and are also listed here. Please rate each feature or column as "Great," "OK," or "No Way." Mail your responses to: 73 Magazine Feedback, 70 Route 202N, Peterborough, New Hampshire 03458.

tion covering the portion where the ground connector of the plug is clamped over the wire. A right-angle bend is then made to the wire at the rear of the connector, after attaching the cover.

I enclosed the bar graph circuitry in a small plastic box that previously held parts. Make an opening for the bar graph display in the middle of the front of the box using a Dremel tool and file. You can then make connection to the Tuner Helper with two-conductor shielded cable, which enters the bar graph box through a rubber grommet on the side so that the cable runs down along the dashboard when the display is mounted vertically. A cable clamp on the circuit board ensures that the cable connections do not twist loose. A Radio Shack board number 276-150 is used for the bar graph circuit construction. Cut the board in half along the outer solder pad number 12, producing two almost square boards. Then these two boards are again cut in the opposite dimension, above the two common solder pad lines, to provide two smaller boards where each chip could be mounted. Solder the bar graph IC to the configuration pads on one board, allowing space on either end for screw holes to be made to attach it, via spacers, to the enclosure through the previously made cutout. Also solder the driver IC to the other board and make connections to the bar graph board, which is placed at a right angle to the driver board, via parallel bus wire. Care must be taken to insure that the two ICs are mounted in a configuration that allows the outputs of one to be parallel to the other's inputs. The remaining connections are then made and the driver board attached to the bottom of the plastic enclosure with double-sided foam strips. Since the enclosure is so small and the display board is attached to the top via screws, no additional attachment is necessary for the bottom board.

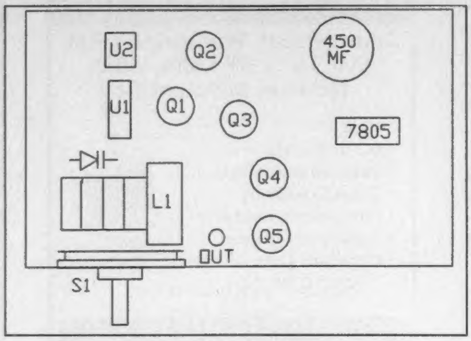


Figure 4. Suggested layout.

Although the audio attenuation resistors are shown on the bar graph schematic, they may be mounted on the main Tuner Helper board, if desired, to save space on the driver board. The trimpot is set by determining which band produces the lowest audio in the installed configuration, and then adjusting the trimmer for about half-scale display on the bar graph. If the strongest band still lights all of the LEDs, then the trimmer can be reset for lower drive level. As shown in the main schematic, the bar graph display is active whether the Tuner Helper is in use or not. If you would rather not have the display react to the receiver audio when not required for tuning, then place the

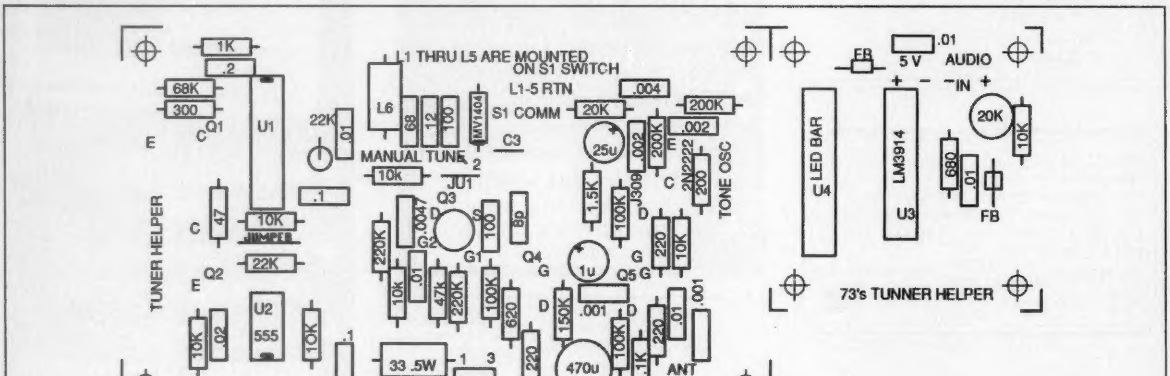


Figure 5. Printed circuit board layout. Pre-made boards are available for $6.00 cash plus $1.50 S&H per order from FAR Circuits, 18N640 Field Ct., Dundee, IL 60118.

voltage supply line to the 5-V regulator dropping resistor on the output side of power switch S2.

Although the Tuner Helper originated to meet a specific need, it has also found use as a signal generator on the test bench for filter design, receiver alignment, and antenna testing.

References

Veronese, Fabio, "Build A 'Gate-Dip' Meter," Popular Electronics, *November 1994.*

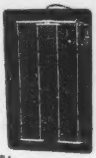
Rakes, Charles D., "Circuit Circus," Popular Electronics, *November 1994.*

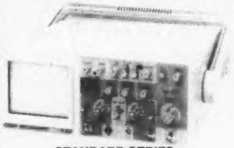
Parts List

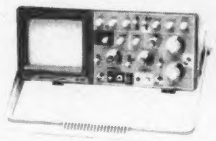
Qty.	Part	Value
1	Resistor	300
1	Resistor	1k
1	Resistor	68k
1	Resistor	47
2	Resistor	22k
1	Resistor	33, 0.5 W
6	Resistor	10k
1	Resistor	47k
1	Resistor	220k
1	Resistor	270
1	Resistor	150k
2	Resistor	100k
1	Resistor	620
2	Resistor	220
1	Resistor	1.1k
1	Resistor	680
1	Trimpot	20k
1	Variable cap	20 pF
1	Mylar cap	0.2 µF
1	Mylar cap	0.1 µF
1	Mylar cap	0.02 µF
1	Silver mica cap	100 pF
1	Ceramic cap	8 pF
1	Ceramic cap	12 pF
1	Ceramic cap	68 pF
1	Ceramic cap	0.0047 µF
1	Ceramic cap	0.1 µF
5	Ceramic cap	0.01 µF
1	Ceramic cap	100 pF
2	Ceramic cap	0.001 µF
1	Electrolytic cap	470 µF, 25 V
2	Ferrite bead	
1	Varicap	MV1404
1	PNP transistor	MPS2907
1	NPN transistor	2N2222
1	Dual-gate MOSFET	40673
2	NFET	J309
1	5V regulator	7805
1	LED driver	LM3914
1	Bar graph display	Radio Shack 276-081
1	J1	P605C jack, T607C plug (Ocean State Electronics)
1	J2	3/8" stereo plug/jack
1	J3	RCA plug/jack
1	Power connector	Radio Shack 274-222
1	S1	Radio Shack 275-1386
1	S2	Radio Shack 275-624
1	Choke	100 µH

Coil Data

L1	3.5-6 MHz	25 µH	T80-6	65T	#28 wire
L2	6-10 MHz	0 µH	T37-6	47T	#30 wire
L3	10-15 MHz	3.6 µH	T37-6	27T	#28 wire
L4	15-22 MHz	1.6 µH	T37-6	18T	#28 wire
L5	22-30 MHz	0.92 µH	T37-6	13T	#28 wire







Number 6 on your Feedback card

Just Another Loop Antenna

Or Is It?

by John Sehring WB2EGQ

Just when you start to feel comfortable with an old, familiar antenna which you think you know all about, along comes a new twist. No, this is not just another antenna article. Question: *Would you like to get some directionality on 75 meters (and 160 capability, too) from a familiar antenna, without moving parts or phased arrays?* Then read on!

I've always liked loop antennas. When they're one wavelength or more in length, they can show a bit of gain over a dipole. They are broadbanded, are tolerant of their surroundings, and seem quieter for reception.

About 10 years ago, when I lived in New Jersey, up went about 275 feet of 14-gauge stranded insulated wire in the shape of an inverted delta loop. Its length was calculated from the formula for the driven element of a square (quad) loop: $L = 1005/F$, where L is the length in feet and F is the frequency, in my case 3.8 MHz. I added about 25 feet of wire "just in case."

The loop was in the shape of an isosceles triangle with the horizontal portion on top, about 45 feet high, and tied between two trees. It looked like an upside-down "delta" and lay wholly in the vertical plane. The plane of the wire ran in the northeast-southwest direction. The bottom end was almost at ground level and came right into the basement shack; so there was practically no feedline, just six feet of extra wires at the ends.

The resonant frequency of the loop turned out to be 3.8 MHz; therefore, the extra 25 feet of wire was necessary. Because my impedance bridge showed the loop's input impedance to be about 165 ohms resistive at resonance, I made up a 4:1 voltage-type balun[1]. The balun transforms the impedance of the antenna downward toward 50 ohms. It also matches the unbalanced coaxial feed to the balanced load of the antenna.

The wire's insulation, while not necessary, does serve three purposes: 1) it keeps RF off of tree branches; 2) due to a velocity factor of about 0.98, it reduces a bit the necessary size of the antenna; and 3) it prevents wire corrosion, which can increase the wire's resistance (especially to RF), thus reducing antenna efficiency[2].

On the air, the loop performed well both transmitting and receiving. Compared to a 130-foot-long, end-fed wire that ran from ground level upward at a 30° angle, it seemed quieter with respect to local QRN and QRM, such as power line noise. During the day, signals from further away were now readable, thanks to reduced noise levels—a definite improvement as the SNR was better.

Surprise!

I discovered an unsuspected facet of the antenna quite by accident. The feed points of the loop were temporarily connected to the balun with alligator clips. One day as I listened to a QSO on 75m, one of the clips popped off. This left only one of the two feed wires of the loop connected and the other dangling.

When that happened, the signal to which I was listening dropped considerably in signal strength but the noise level stayed about the same, indicating that the antenna was still "hearing." Reversing the connections by hooking up the other feed wire of the loop (leaving the first one unconnected) made the signal stronger! Further checking revealed definite directional properties of the loop when it was fed this way. The nulls were quite narrow and deep, and sometimes useful in reducing QRM and QRN. The directionality seemed evident in both azimuth and elevation.

In spite of the interesting directional properties of the loop when fed this way (end-fed with an L-network against ground, like the high impedance end of a long wire), the balanced feed produced stronger signals on both transmit and receive for the kind of casual operation (out to 1,000 miles) that I usually do on 75m. So I left the end-fed arrangement for receive-only use, where signal-to-QRM and/or signal-to-QRN ratio, not just signal strength alone, are important for hearing a desired signal.

DX

Then, during the cooler months came some excellent DX propagation conditions on 75m. Surprisingly, the end-fed configuration was often superior to the balanced feed. It usually elevated DX signals from the northeast direction (for example, Europe from New Jersey) by a few dB or so and, at the same time, suppressed stateside signals and QRN significantly. Curiously, these effects occurred most often when feeding the wire end toward the northeast; here was that directionality again.

Evidently, the end-fed loop had a high elevation angle null in its pattern, tilted away from the end that was being fed. Local signals and noise were suppressed as their high angle of arrival put them right into the null.

What I had found here was an

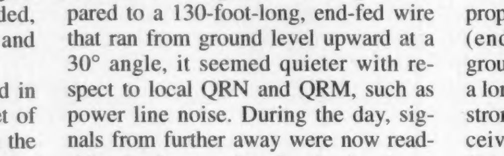


Figure 1. Current distribution of a half-wavelength dipole.

ASTRON CORPORATION
9 Autry
Irvine, CA 92718
(714) 458-7277 • FAX (714) 458-0826

MODEL VS-50M

ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

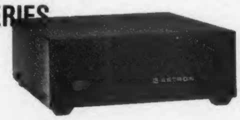
SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-3A, RS-4A, RS-5A, RS-4L, RS-5L
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES



• LOW PROFILE POWER SUPPLY

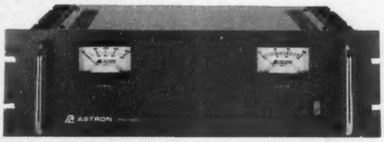
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES

• POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

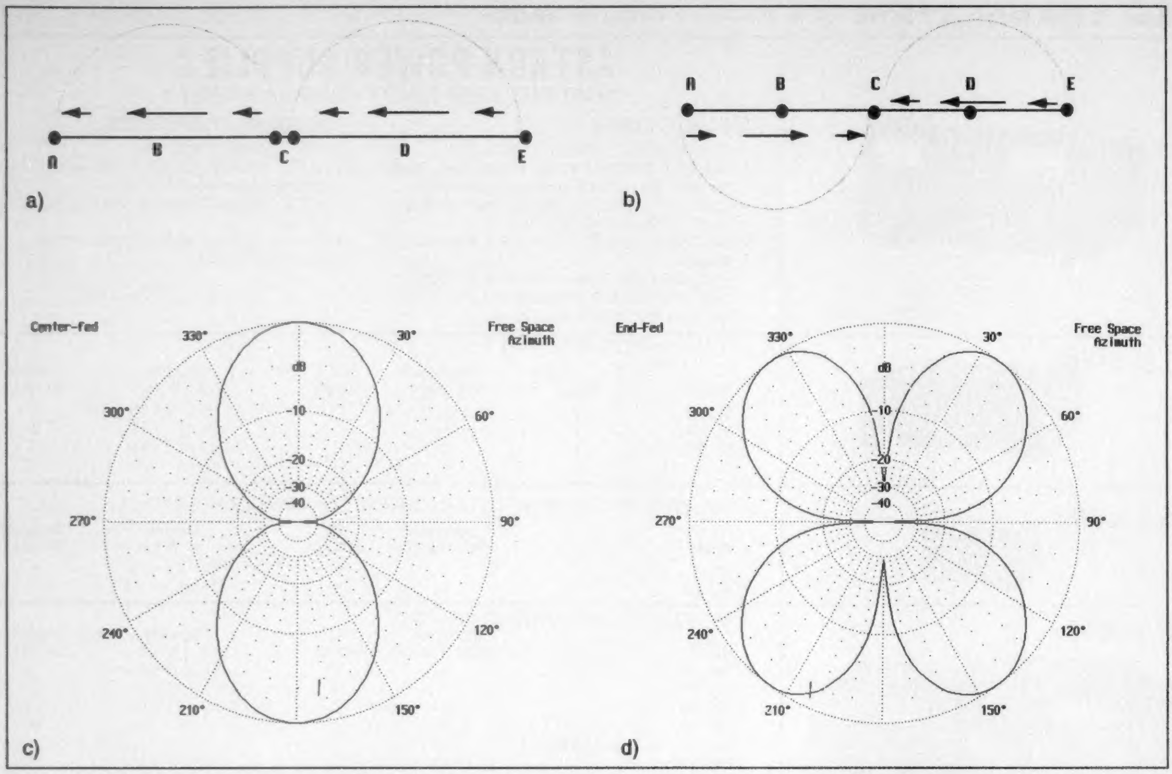


Figure 2. A) current distribution of an end fed full-wavelength antenna; B) current distribution of a full-wavelength center-fed antenna; C) radiation pattern for a center-fed one-wavelength antenna; D) radiation pattern for an end-fed one-wavelength antenna.

antenna of flexibility, capable of strong high-elevation angle performance for stateside contacts (when balanced-fed) and, at the flip of a switch, improved performance for DX with a low-angle lobe and simultaneous high-angle rejection (when end-fed). An added bonus was the 180° switchable endfire directivity.

No, it cannot compete with a dipole at 150 feet, or phased vertical or parasitic arrays, but the improvement over a typical low dipole or inverted-vee is obvious, and the complexity and cost is minimal.

Some Detective Work

The loop's unusual properties when end-fed caught my interest. To see what was happening, I compared the antenna's current distribution in free space with both balanced- and end-feed, so I could estimate what kind of radiation patterns they would produce. Yes, there are computer programs that analyze antennas, but they are most efficiently used when you have at least a qualitative understanding of how an antenna works. I'll touch on this again.

Half-Wavelength Wire

Figure 1 shows the current distribution of a half-wavelength dipole that is sinusoidal. The dotted lines show the amount of current in various parts of the antenna. The arrows show both the direction of current flow and, by their length, the amount of current flow where they are drawn, like a vector.

The relative amount of current at a point on an antenna can tell us the impedance there. Since impedance equals voltage divided by current ($Z = E/I$), high current indicates a low feedpoint impedance and, conversely, low current indicates a high impedance.

The amount of current in a dipole is highest at its center (point B), giving a low impedance there. We know this to be true, as its impedance when center-fed is usually about 50 to 70 ohms.

At each end of the dipole we have current minimums. It has to be this way because it's the end of the antenna and so current cannot flow to anywhere. The impedance there, at points A and C, is therefore high.

To avoid upsetting the symmetric current distribution of a dipole when center feeding it, we need to use a balanced feed (a coaxial feedline would need a balun). A balanced feedline presents equal but opposite polarity (plus and minus) voltages, so its presence in the center of a dipole would not disturb current distribution there.

Full-Wavelength Wire

Now we'll extend our wire to one full wavelength and draw the current flow again (see Figure 2). If we feed it at the center (point C), we get the current distribution shown in Figure 2A. There are now two current maximums, at points B and D. Current in both halves is forced to run in the same direction (they are in phase) by the feedline. Current is at a minimum in the center and at both ends (points C, A, and E, respectively).

But if we feed this antenna at an end instead of the center, the current distribution will be quite different, as seen in Figure 2B. There are once again two current maximums. But current in the two halves now runs in opposite directions (they are anti-phase). It could be fed at either end, point A or E, which are, once again, high impedance points.

Since it is current flow (its strength and direction) that generates a radiation pattern from an antenna, we expect

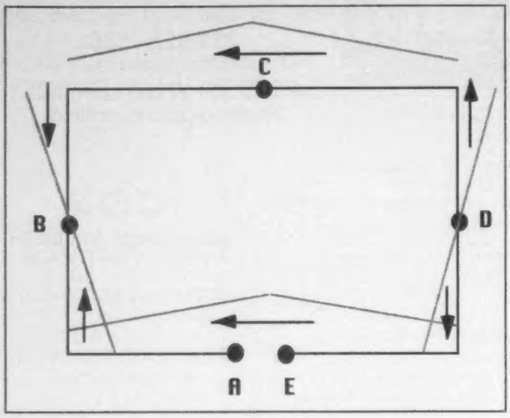


Figure 3. Current distribution of a quad loop.

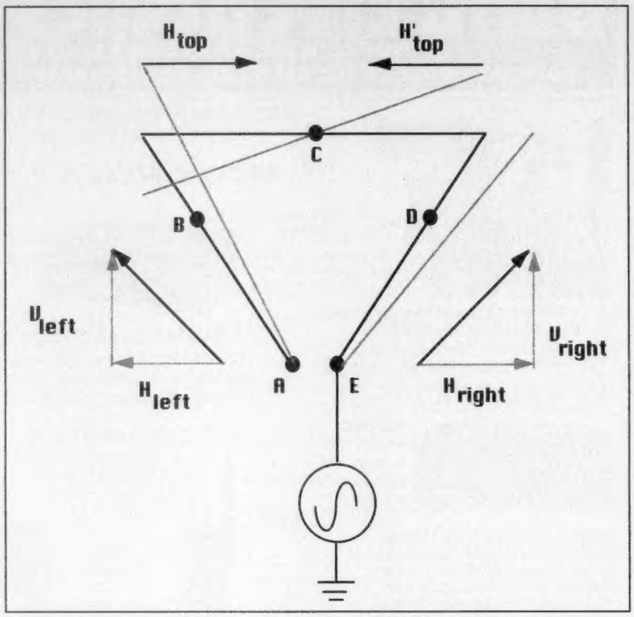


Figure 5. Current distribution of an end-fed full-wavelength loop.

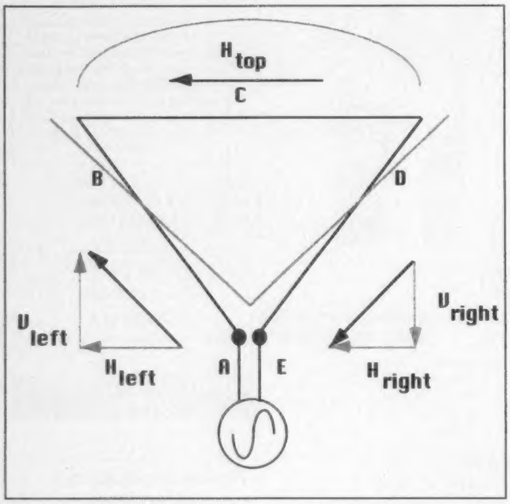


Figure 4. Current distribution of an inverted delta loop, balanced fed.

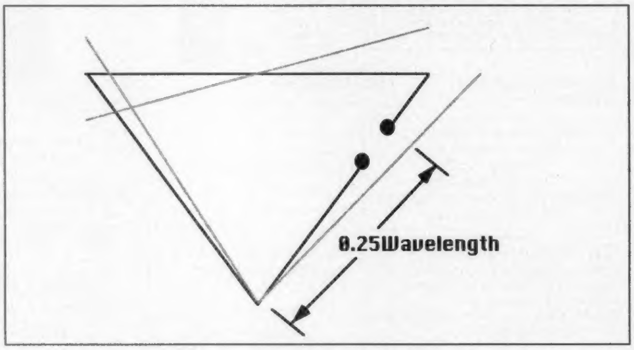


Figure 6. Current distribution of an inverted delta loop, side-fed.

(correctly so) that the directivity will be different when it is fed in these two different ways.

Looking at the end-fed antenna plot from a direction perpendicular to the wire's axis, radiation from the two equal but opposing currents cancels. On the other hand, the center-fed antenna's inphase currents add up to produce maximum radiation in this same direction. Figures 2C and 2D show this (the plots are for free space patterns; the wire axis runs side to side in both plots).

So, by simply moving the feed point, we can get very different radiation patterns from the same piece of wire.

Balanced-Fed Loop

Let's now draw the current distribution for a balanced-fed inverted delta loop by starting with a quad (square) loop. You can think of a quad loop as two half-wavelength dipoles stacked a quarter wavelength apart, with their ends bent up (and down) to touch each other. See Figure 3.

We know from our experience that the quad loop has a low input impedance, so current must be at a maximum at the center feed point, point A-E (and also at point C opposite the feed point). The quad's upper and lower halves' current distribution does in fact correspond to a pair of dipoles. Compare the current distribution of the top and bottom halves of the quad with the dipole shown in Figure 1: They are the same.

We can now reshape the quad loop, along with its current distribution, into an inverted delta loop shape, shown in Figure 4. To see what's happening, we break the side leg currents into their horizontal and vertical components, H and V. These are shown as Hleft and Vleft for the *horizontal* and *vertical* components on the left leg of the loop, and as Hright and Vright for those on the right leg. The current in the top section, Htop, flows strictly in the horizontal direction (to the left).

The horizontal side currents Hleft and Hright both run in the same direction as the horizontal current Htop in the top portion of the antenna (to the left), so all three add up. Hence we have horizontally polarized broadside radiation from this antenna.

We see that Vleft and Vright go in opposite directions (up and down, respectively). Therefore, these vertical current components cancel each other in a direction broadside to the loop—that is, in and out of the plane of the page—and there is no broadside vertically polarized radiation. (Due to the side leg spacing, there will be some vertically polarized radiation in the endfire directions.)

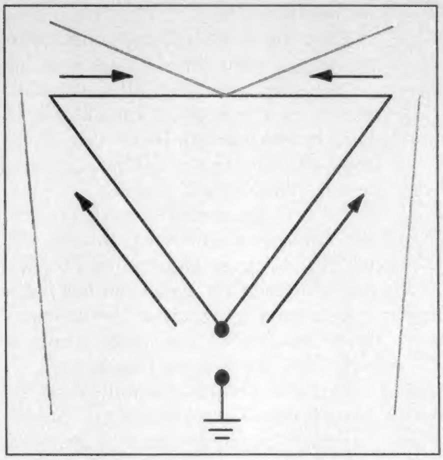


Figure 7. Current distribution of an inverted delta loop, F = 1.9 MHz, fed as a vertical element.

End-Fed Loop

Now what about feeding only one of the wires, leaving the other unconnected? Let's fold the one-wavelength, end-fed wire of Figure 2B into an inverted delta shape along with its current distribution (see Figure 5).

We now have high impedance at our feed point as the current maximums have moved to points B and D of Figure 5. This altered current distribution in the loop changes its pattern, just as we saw with the straight wires in Figures 2C and 2D.

In this case, there are two horizontal currents (Htop and H'top) in the top portion that are equal in strength but run in opposite directions and so cancel. The side leg currents, broken again into horizontal and vertical components, show that Hleft and Hright also run in opposite directions and they too cancel. The result is no horizontally polarized radiation.

But the vertical components Vleft and Vright now run in the same direction (up) and so aid each other. Thus, we have vertically polarized broadside radiation from the antenna when it is fed this way.

And depending on the spacing of, and relative phasing of current in, the two side legs, we also have the potential for endfire vertically polarized radiation. But we haven't yet explained the two different endfire directivities noted on the air.

Endfire Directivity

The end-fed loop currents in the side legs should be in phase with each other since the distance from the feed point to the end of the antenna is exactly one wavelength; 360° of phase shift brings you around to 0°, in phase again. If this were actually so, the end-fed loop would have exactly the same pattern in both endfire directions.

But this is not so. We have observed endfire pattern changes when switching feeds from one end to the other. This could occur only if there were an extra amount of phase shift in the currents as they moved along the wire. What can the source of this phase shift be?

Traveling Waves

It is caused by "traveling waves" on the antenna. Non-center-fed antennas display a traveling wave effect. This shows up as an increasing phase shift in the current as we move away from the feed point. It is mostly the result of RF energy being radiated from the antenna. The effect of the traveling wave is to skew the pattern of an antenna, pulling it in the direction of the wire axis away from the end feed point[3, 4, 5].

In the case of our end-fed loop (which, you recall, is a bent, end-fed antenna), it makes the pattern nonsymmetric in the two endfire directions. This shows up as different low-angle gain and a high-elevation angle null that is tilted away from the end being fed.

Side Feed

Another possible feed arrangement for the inverted delta loop is to break it at an upper corner to feed. This is reported to be a good configuration for DX with a strong, low-elevation angle, a vertically polarized lobe, and only a weak high-angle lobe[6].

A further refinement is to feed it below the upper corner, on one side leg, at a distance of a quarter wavelength up from the wire axis at the bottom (see Figure 6)[7]. This side feed location forces the currents in the two bottom legs to reverse direction exactly at the bottom junction and exactly in the middle of the top section, when the loop is operated at resonance.

This gives perfect current symmetry: The vertical components add up and the horizontal components cancel, to the greatest possible extent. This maximizes the strength of the low-elevation angle lobe, while producing the deepest high-angle null.

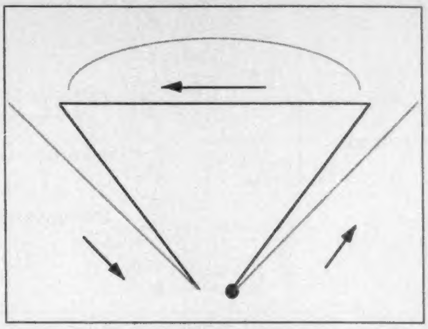


Figure 8. Current distribution of an inverted delta loop, F = 1.8 MHz, end-fed.

Surprise Number Two

Drawing the currents of the side-fed loop shown in Figure 6 reveals a startling fact: The current distribution is exactly the same as for our end-fed loop! Compare it with Figure 5.

I had long wanted to try the side feed arrangement, but was daunted by the fact that this configuration would not be optimum for non-DX contacts and that the upper corners of my loop were located in high trees. So there would be no easy, quick way of changing the feed point from bottom to side, and vice versa, to switch modes. End feeding the loop solved these problems and gave switchable endfire directivity, too.

You Mean There's More?

Yes, 160m can also be had with this piece of wire Here's how: If you could grab the middle of the top of the loop and stretch it all the way up, you'd have a quarter-wavelength long, 160m vertical antenna consisting of two parallel wires connected at the top.

So I thought to feed the wire as a "squashed" or wide cage quarter-wavelength long vertical antenna. I did this by tying both bottom ends together and feeding them against ground. The input impedance was about 50 ohms.

Once more we can plot the currents (see Figure 7), remembering that on 160m the wavelength is twice as long as on 80m. Based on an analysis of the current as before, the horizontal components of the current in the sides and top run in opposite directions and so cancel. This leaves only the vertical components of current in the sides running in the same direction (up) and so add together, and we have vertically polarized radiation.

Another ham suggested that I ground one end of the loop and feed the other against ground. This turns it into a conical, vertical, folded unipole (half of a

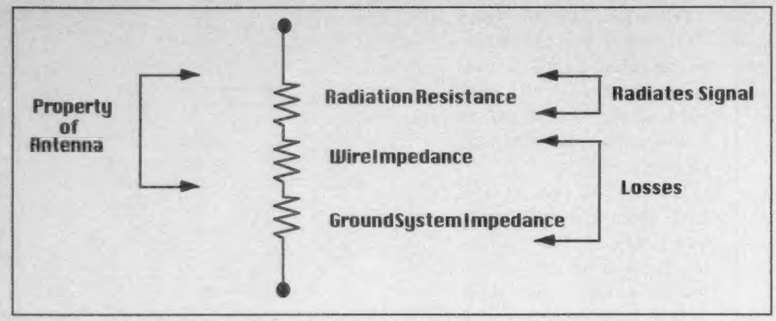


Figure 9. Equivalent circuit of a vertical antenna and ground system.

folded dipole). The feed point impedance is about 75 ohms, which still allows direct coax feed. This configuration works about as well as the squashed vertical feed arrangement above but is sometimes noisier on receive.

Don't kid yourself about improved efficiency here, though. It's just the input impedance of the antenna that's been stepped up by the folded dipole action. Series losses due to ground resistance are still there to the same extent[8].

Let's give that end-fed trick a try on 160 too, again using the L-network and fed against ground. We could be surprised some more; it sometimes worked better than the squashed vertical configuration and occasionally displayed some mild directivity when I swapped feed ends. Looking at the currents (Figure 8) shows that it's a mostly straight-up, horizontally polarized broadside radiator with vertically polarized endfire radiation. This should give a decent combined polarization, omnidirectional pattern.

Ground System

In general, you need a good ground system to get the most out of antennas that produce vertically polarized radiation, as our end-fed and squashed vertical fed loop does.

With a base-fed quarter-wavelength vertical antenna, current flow is maximum at its bottom end, right next to the ground. The amount of ground current that is caused to flow depends on the amount of antenna current flow closest to the ground.

As a result, a large amount of current will flow in the nearby ground around the base of a quarter-wavelength antenna. This leads to highest I2RGROUND losses as the ground currents fight their way, in a radial pattern, back to the base of the antenna through lossy soil, heating up the dirt.

For this kind of antenna to work most efficiently, the ground system must intercept as much of the surrounding ground current as possible and convey it, with the least amount of loss, back to the base of the antenna.

As the ground resistance appears in series with the impedance of the antenna, power applied to the antenna will divide between them depending on the relative impedances. The ground system is therefore very important for good performance in this situation. A good radial or counterpoise (elevated radial) system, plumbing connections, ground rods, and so forth are needed to get the most performance from such antennas.

This shows why we need to think of the combination of antenna and its ground as a system.

160m Ground

On 160m, we're running the squashed vertically fed loop just like a quarter-wavelength vertical antenna (maximum current at the bottom end of the antenna), and so a good ground system is necessary.

Since the measured input impedance of our squashed vertical loop is about 50 ohms resistive at 1.9 MHz, it can be directly fed with coax. The antenna is quite broadbanded on 160m due to 1) its large effective diameter (like a cage antenna), and 2) ground losses.

But both my computer modeling and the *Antenna Engineering Handbook*[9] tell me that the actual impedance (radiation resistance, the useful part that actually radiates a signal) of the antenna, when fed this way, is about 20 ohms rather than the 50 ohms I measured.

This means that the additional 30 ohms is due to a combination of ground resistance (about 28 ohms[10]) and wire impedance (about 2 ohms; this is not DC resistance but the RF impedance of the wire that is higher due to the skin effect—see Reference 1) that show up in series with the radiation resistance of the antenna. Figure 9 shows the equivalent circuit of the system.

This causes inefficiency, about 8 dB worth, which means I'm throwing about 60% of the power away with my particular ground system! A better ground system would reduce this loss and thereby increase antenna efficiency.

Your tip-off here to better performance is that the antenna's measured input impedance will drop toward, but won't quite ever reach, about 20 ohms as the ground system is improved.

75m Ground

When our loop is end-fed on 75m, its current maximums (points B and D in

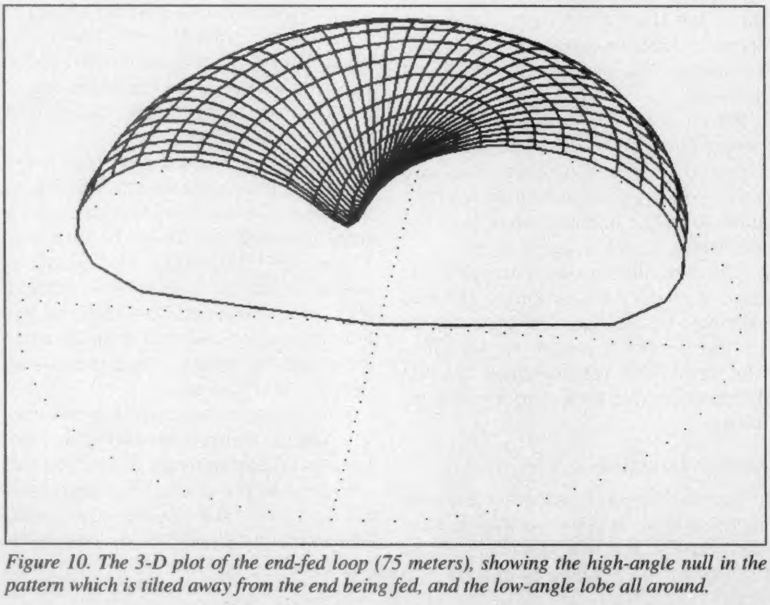


Figure 10. The 3-D plot of the end-fed loop (75 meters), showing the high-angle null in the pattern which is tilted away from the end being fed, and the low-angle lobe all around.

Figure 5) are raised up off the ground, to a height approaching a quarter wavelength. Recall that it produces vertical polarization when end-fed. Its current distribution is like a half-wavelength vertical antenna, with the current maximum now raised up a quarter wavelength in the air. Rotate the dipole of Figure 1 by 90° and put one end touching the ground to see this.

Because antenna current at the bottom end of the antenna, near the ground, is now minimum, less (lossy) ground current is induced. Also, the feed point impedance is now higher so that relatively less voltage gets developed across the ground system impedance, as in Figure 9. This means that ground system requirements are less stringent for our end-fed loop on 75m than they are on 160 m[11].

Because those parts of the antenna radiating the most (the current maximums) are now raised off the ground, the end-fed loop on 75m shares some of the other advantages of a half-wavelength vertical antenna: 1) A slight lowering the elevation angle of radiation; and 2) Better clearance of nearby obstacles. Overall, there is a reduction of ground, environment, and feed losses, relative to a base-fed quarter-wavelength vertical.

My loop worked satisfactorily with four insulated-wire, quarter-wavelength radials that just lie on the ground. Two radials are cut for 75m and two for 160m. They lie in the plane of (directly beneath) the antenna in both directions. This arrangement of radials gives me maximum measured RF ground current.

Broadcast Band

Since the upper edge of the standard AM broadcast band lies just below 160m, I thought to try the antenna and its feed variations there. I noted different reception effects when changing among the feed types, down to about 1100 kHz though they are strongest toward 1600 kHz.

For example, feeding the antenna as a squashed vertical brought one vertically-polarized 50 kW BC station on 1560 kHz located within ground-wave range well up in signal strength. Switching to end feed suppresses it so greatly (20 to 30 dB) that co-channel skywave-propagated stations never before heard become audible.

On one occasion, switching among balanced, end, and squashed vertical feed allowed three different co-channel stations to be logged. This is an admittedly rare occurrence but illustrates how useful selectable directivity and polarization can be.

SWLing

As the loop shows numerous HF resonances, it's not surprising that it's useful all the way up to the top of the HF spectrum and beyond. Once again, the various feed arrangements are useful in optimizing HF reception. As before, some feeds optimize SNR and some optimize signal strength; they are not always the same!

Since the antenna is so broad and flexible, I believe that construction of the largest loop within the limits of available real estate and supports, regardless of its size (and therefore resonant frequency), would provide an excellent SWL antenna. The L-network could probably be dispensed with for reception, but you'd definitely want to be able to switch easily among various feed arrangements.

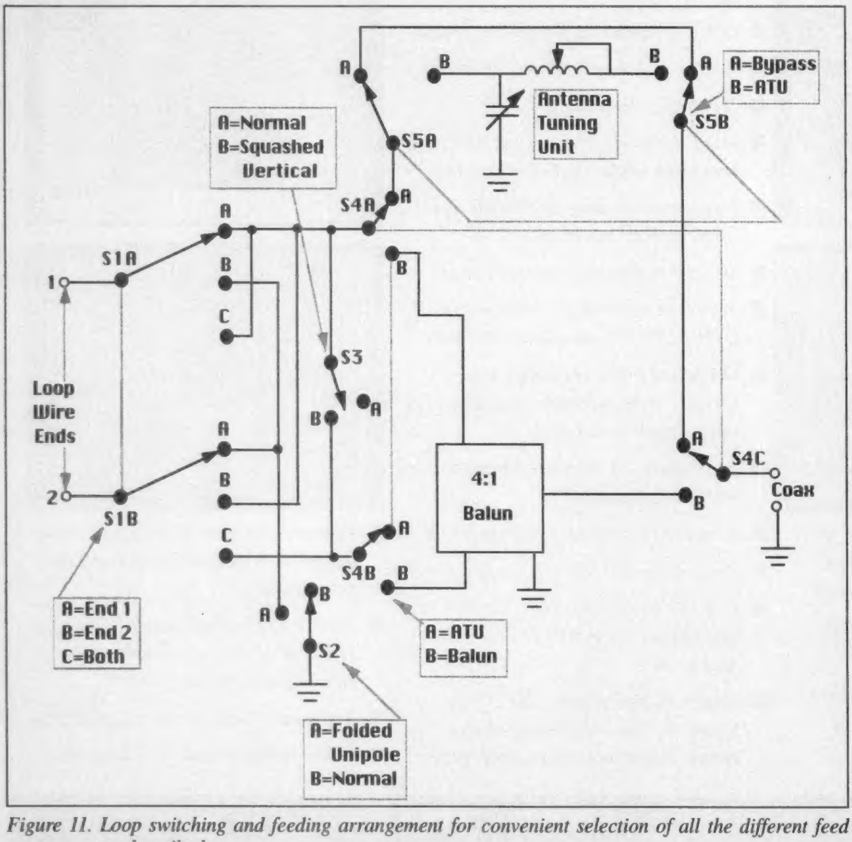


Figure 11. Loop switching and feeding arrangement for convenient selection of all the different feed arrangements described.

Other Bands

The loop also works fine on 40, 20, 15, and 10 meters using the various feed and matching arrangements. I haven't tried it on 30, 17, or 12 meters yet but I'd expect good results there too.

Other Loop Shapes

I think it's worth trying these various feed arrangements with any other loop shape (quad, delta, circular, and so forth) as well, no matter what their height above ground, or length and type of feedline, or whether they are oriented in the vertical or horizontal plane, or anywhere between.

Computer Modeling

After using the antenna for several years, I was able to model it using the MININEC antenna analysis program. MININEC has certain limitations when modeling antennas with horizontal wires, or horizontally flowing currents, less than 0.2 wavelengths off the ground: For example, gain predictions will be too high, but pattern shapes will be reasonably correct[12].

The analysis clearly revealed what I had noticed on the air when end feeding the antenna on 75m. The 3-D plot shown in Figure 10 shows the high-angle null in the pattern that is tilted away from the end being fed, and the low-angle lobe all around.

Summary

This article has described four different ways of feeding an inverted delta loop antenna: 1) balanced feed at bottom; 2) end-fed at bottom (one wire fed and the other wire left floating); interchanging the fed end swaps the endfire directional patterns; 3) one wire-fed and the other wire-grounded, a folded unipole; 4) both bottom end wires tied together, fed against ground, as a squashed vertical.

Figure 11 shows a switching arrangement for convenient selection of all the different feed arrangements. This could also be done with patch cords and alligator clips.

I would enjoy hearing about your experiences with this kind of antenna (Box 373, Baker, MT 59313). Please include an SASE if you'd like a reply.

Epilogue

Since moving to Montana, I have put the antenna up again. Unfortunately, I have just one row of relatively short trees to use for supports, so the loop now lies in a plane tilted about 20° from horizontal. The top of the loop still runs horizontally for about 95 feet, but is only 30 feet high.

The side legs are quite unequal in length. One leg is partly draped over the roof. The lower end of the loop (the feed point) slopes downward. The feed point is about 10 feet above ground. The feedline consists of a parallel run of extra wire that runs into the shack (again in the basement!).

In spite of these handicaps, the loop still shows some directivity effects and can be used in all the ways previously described. When end-fed on 75m, it does not have the low-elevation angle capability of the original arrangement, though. When balanced-fed, it's more of a "cloud warmer" but is still quite satisfactory. It seems to have better performance on 40m than before.

On 160, it's now electrically too long for resonance at 1.9 MHz, so I use a three-gang AM broadcast receiver-type variable capacitor in series with it to tune out the inductive reactance. When fed against a decent ground, its input impedance approaches 50 ohms resistive.

It works surprisingly well on 160 meters for such a low antenna; its top is only about 0.12 wavelength off the ground on 160m. However, soil conductivity is quite high here due to a large amount of dissolved alkaline minerals. This would enhance the performance of the antenna considerably. ■

References

1. The ARRL Handbook, *American Radio Relay League, 1983, p. 19.7. Plans for a balun can be found in almost any amateur radio handbook. Orr, W. I.*

2. Radio Handbook *(21st Ed.), Editors and Engineers Div. of Howard W. Sams, Indianapolis, 1978, p. 3.18. As frequency is raised, more and more of the current is forced to flow in the outer layers of a conductor toward its surface. This means that corrosion of antenna wires or elements, which occurs on the surface, can have a stronger effect on antenna losses because more of the RF current flows there. Insulated or coated, wire and elements can prevent corrosion.*

3. Rautio, J.C., "The Effect of Real Ground on Antennas—Part 5," QST, *November 1984, Figures 4H-4L, 5.*

4. The ARRL Antenna Book, *American Radio Relay League, 1974, p. 58, Figures 2-70.*

5. Balanis, C.A., Antenna Theory, *Harper-Row, New York, 1982, pp. 372-374. Additional traveling wave effects are caused by wire impedance and ground effects.*

6. Mayhead, L. V., "Loop Aerials Close to the Ground," Radio Communications, *May 1974, Figures 9, 15. Gives experimental results from measuring scale-model, variously shaped and fed, one-wavelength loops over a metallic ground.*

7. Devoldere, J., Low-Band DXing, *ARRL, 1987, p. II-49, Figure 2.55(C). I adapted his feed idea for a delta loop for use with an inverted delta loop.*

8. Devoldere, p. II-25, par. 2.4.4.

9. Jasik, H., ed., Antenna Engineering Handbook *(1st edition), McGraw-Hill, New York, 1961, Figures 3-13.*

10. Devoldere, op. cit., p. II-24, Table 12, "Equivalent Series Resistance of Radial Systems in Ohms." See entry for two quarter-wavelength radials.

11. Belrose, J. S., "160-meter Antennas," Technical Correspondence, QST, *July 1991, p. 49-50.*

12. Lewallen, R., "MININEC: The Other Edge of The Sword," QST, *February 1991, pp. 18-22. There is also a well-known frequency offset error in this program for which I have accounted in my analysis. This article gives a good overview of the program.*

A Discone Antenna for 10 Meters

It looks like a bird cage, but works like a yagi.

by O.B. Boddie W1ZB/6

A truncated cone antenna is a superior radiator, equaled by none. The cone antenna is used extensively on VHF and UHF, and the Skelton cone is a version of it for HF.

The discone antenna described in this article resembles the old cage antenna of the spark days. My XYL says it looks like a bird cage. But, looks can be deceiving. This small antenna was tested extensively, with a 6-dB gain three-element yagi as a standard. It proved equal to the yagi in every way.

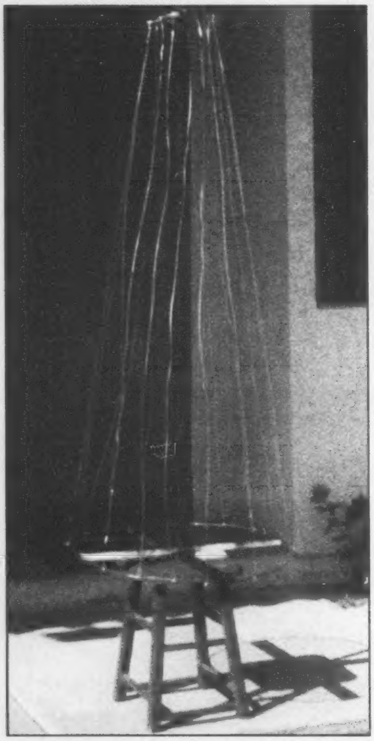


Photo A. Finished discone antenna.

This discone antenna has a gain of 6 dB across the entire 10 meter band. How does it do this? It has an infinite number of half waves in parallel for a radiation pattern. It always has the right angle of radiation because of the rotating field pattern.

> *"This is fine for apartment dwellers and works well from the inside of the apartment because of the multi-angle radiation pattern."*

You can build it as a single cone 5 feet high to sit on the roof, giving you a 3-dB gain in all directions at a low angle. This is fine for apartment dwellers and works well from the inside of the apartment because of the multi-angle radiation pattern. It is easy to construct and the cost is so low that anyone can afford to build it. Or, you can construct two cones separately and hang them both from the ceiling or under the eaves on a house or garage. Mine are hung in the shape of an inverted "V" and favor signals broadside. Mounted vertically, it radiates in all directions with a 3-dB gain when using only a 5-foot antenna.

The low angle of radiation makes this cone an excellent DX antenna. It even picked up a few new countries I could not raise on the yagi! For 20 meters, double all measurements and you can have a 6-dB gain antenna on 14 MHz.

If you are using a single cone antenna, no tuner is necessary. On the discone antenna, however, an antenna tuner may be necessary for a perfect match.

Construction Details

These details are for a single cone. Make two of them for a discone.

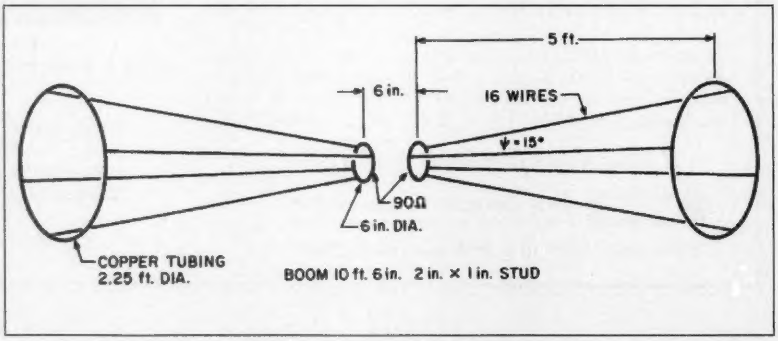


Figure 1. Discone for 10 meters.

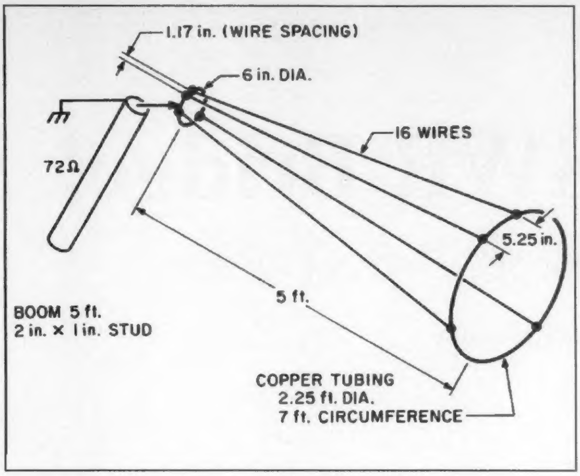


Figure 2. A 10 meter conical.

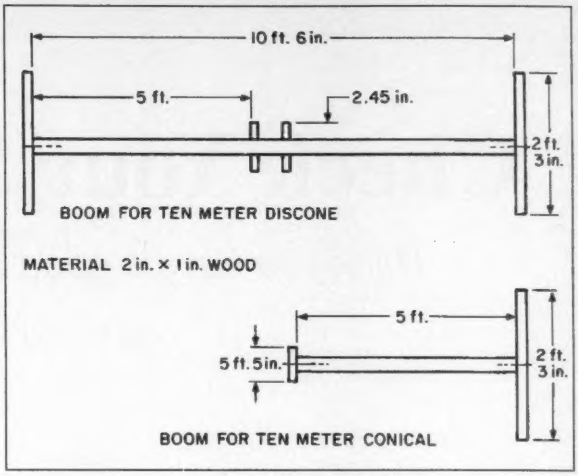


Figure 3. Boom for conicals.

First, make the booms, following the details in Figure 1. Next, cut a 7.20-foot piece of copper tubing. Flatten one inch on the ends with a hammer. Bend it in a circle. Drill through the flattened ends with a #18 drill clearance for an 8-32 machine screw.

Cut off a 20-inch piece of copper tubing. Flatten 1 inch on the ends with a hammer. Bend this piece of tubing in a 6-inch circle. Drill through the flattened ends with a #18 drill clearance for an 8-32 machine screw.

Bolt together the two copper tubing circles with 8-32 machine screws.

It is easy to construct and the cost is so low that anyone can afford to build it.

Insert the tubing circles onto the boom for fit. Shave down the wood for fit. Flatten the copper tubing where it goes over the 2-inch by 1-inch ends of wood.

On both the large and small loops, drill two holes through the copper at the flat portion to clear 5/8-inch by 8-inch wood screws. Remove the copper tubing loops and drill 1/16-inch holes, evenly spaced, in 16 places on each copper tubing loop.

Assemble boom and copper tubing loops together. Tighten the wood screws to hold the assembly together. String 16 wires as per Figure 4 after scraping enamel off the ends of wire for good contact.

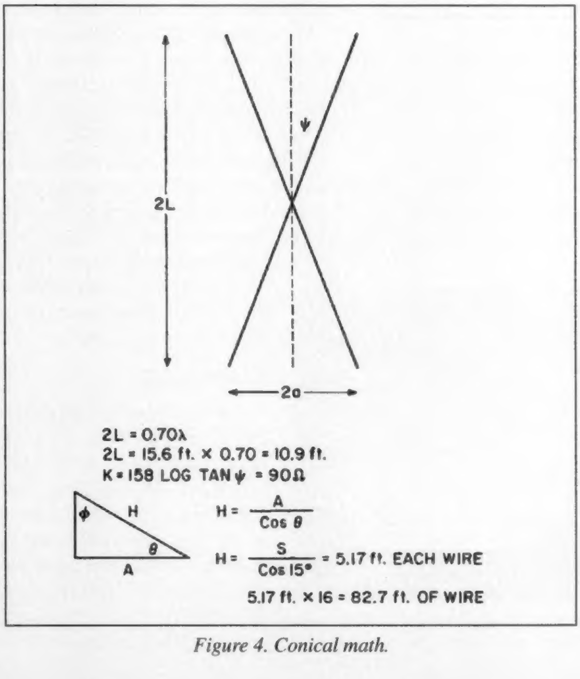


Figure 4. Conical math.

Parts List (for one cone; double for discone)

10 feet of 1/4 inch copper tubing
100 feet of #18 copper wire enamel covered
32 each 3/8 inch #6 pan head sheet metal screws
2 each 1 1/2 inch #8 flat head Phillips brass wood screws
2 each 8-32 1/4 inch-long machine screws and nuts
1 five-foot 2 inch x 1 inch wood stud for boom
1 two-foot-3-inch 2 inch x 1 inch wood for end piece
1 six-inch 2 inch x 1 inch wood for end piece
Note. For the discone, two cones make the boom 10 ft. 6 inches long.

Construction

1. Make booms as per drawing.
2. Cut off a 7-foot 3-inch piece of copper tubing. Flatten 1 inch on ends with hammer. Bend it in a circle.
3. Drill through flattened ends with a #18 drill clearance for an 8-32 machine screw.
4. Cut off a 20-inch piece of copper tubing. Flatten 1 inch on ends with hammer. Bend it in a 6-inch circle.
5. Drill through flattened ends with a #18 drill clearance for an 8-32 machine screw.
6. Bolt together copper tubing circles with 8-32 machine screws.
7. Insert copper tubing circles on to the boom for fit. Shave down wood for fit. flatten copper tubing where it goes over 2 inch x 1 inch ends of wood.
8. Drill two holes through copper at flat portion to clear 1 1/2 inch x 8 wood screws.
9. Do this for large and small loops of copper tubing.
10. Remove copper tubing loops and drill 1/16 inch holes in 16 places on each copper tubing boom evenly spaced.
11. Assemble boom and copper tubing loops together. Screw down wood screws to hold assembly together.
12. String 16 wires as per drawing after scraping enamel off the ends of wires for good contact.

Check Your SWR Bridge!

Think you have a good bridge? Find out for sure.

by W. Paul Wing K1WVX

You should check your SWR (Standing Wave Ratio) bridge, rather than assume that you have a good one. Good-quality SWR bridges that have been left in the line have usually been overranged a number of times. Many inexpensive bridges have poor accuracy. Most SWR bridge construction articles only provide instructions for checking at an SWR of 1:1. This one-point check, which is made by using a standard 50-ohm dummy load, is inadequate.

I will describe how to use resistances in conjunction with your 50-ohm dummy load to check your bridge at several test points.

Resistances to Use

The easiest way to check your bridge at an additional point is to borrow a friend's 50-ohm dummy load and connect it in parallel with your own. You can make this connection with a coaxial tee and a short length of coaxial cable, as shown in Photo A. The resulting 25-ohm dummy load will produce an SWR of 2:1. The reason for this is that the SWR is equal to the ratio between the line impedance and the load resistance, which is 50/25 = 2.0. When necessary, this ratio is inverted in order always to produce a ratio greater than 1. This subject is more fully covered in *The ARRL Antenna Book.* If you cannot borrow a second dummy load, you can easily make one for use at reduced power. The construction of the unit will be covered in a subsequent paragraph.

Also, if you make a 25-ohm dummy load having two connectors, it can be used in series with your 50-ohm load to produce an SWR of 1.5:1, and it can be used in parallel to produce an SWR of 3.0:1. If both "add-on" dummy loads are provided, SWR values of 1.5, 2.0, and 3.0 can be checked, in addition to the usual 1.0 SWR check.

Reduced Power Dummy Load

The main difficulty with building dummy loads is that noninductive resistors are not generally available with power ratings above two watts. In order to avoid using 50 of these for each load, I chose to use a smaller number of 2-watt resistors in combination with my 50-ohm dummy load, and also to use reduced power. A transmitter output power of 35 watts was selected in order to substantially reduce the number of resistors required. Almost all solid state and tube-type transmitters can be reduced to the 35-watt output level by using the front panel controls. Remember that this is approximately equal to 70 watts of input power. Some SWR bridges are not sensitive enough to get readings on 75 and 80 meters with reduced power. In this case, the testing is limited to 10 through 40 meters.

"The main difficulty with building dummy loads is that noninductive resistors are not generally available with power ratings above two watts."

Accuracy

Two-watt resistors with tolerances of 2%, 5%, and 10% are usually available in radio parts stores. I used 2% resistors because they are not very expensive, and improve the overall accuracy. My conventional 50-ohm dummy load measures 47 ohms. This is an error of 6%. When this is used with an "add-on" load having an accuracy of 2%, the maximum errors range between 3.4% and 4.7%, depending on which test is being performed. This accuracy is considered adequate by most amateurs.

If you wish greater accuracy, you can build and substitute an additional 50-ohm load with 2% resistors. This will result in a complete 2% system. The power rating will remain at 35 watts.

Construction

I will describe first the construction of the 25-ohm unit. It uses twelve 300-ohm resistors in parallel. The schematic is shown in Figure 1, and the completed unit is shown in Photo B. I used Radio Shack perfboard No. 276-1396A. It is 1/16" thick and has holes spaced 0.10" x

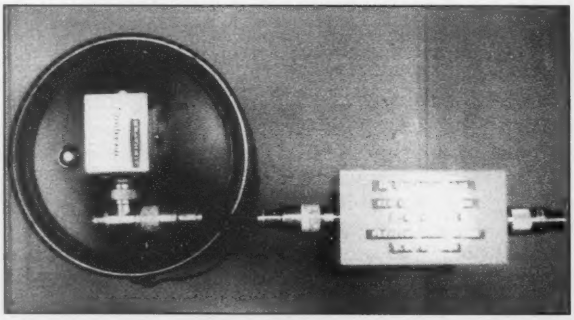


Photo A. A conventional 50-ohm dummy load, connected in parallel with an "add-on" load. The feedline is connected at the coaxial tee.

0.10" apart. Cut a piece of this perfboard 1-7/8" x 3-1/16" so that it has 18 holes along the short side and 30 holes along the long side. Drill two 1/8" diameter mounting holes at diagonally opposite corners, as shown in Photo B. These holes are located 7/32" from both edges of the board. Also cut five pieces of perfboard 1/2" x 2-5/16" long. These will be used as spacers during soldering. Bend both leads of the twelve resistors 90 degrees so that they will fit through holes in the perfboard that are 0.90" apart. Stack three spacers on the board and hold them in place with masking tape. Install six resistors on top of the spacers with their leads going through holes in the board. The resistors are spaced 0.40". from each other. Hold the resistors in place with masking tape.

Cut two pieces of No. 14 AWG copper wire 4" long. Solder one of these wires to the six resistor leads, as shown in Photo B. The wire is positioned 1/8" above the board by using the two remaining spacers. Turn the board around and repeat this process to solder the other #14 wire.

Stack the two spacers on top of the lower row of resistors and fasten with tape. Install the six top row resistors and solder their leads to both wires. Cut the lead lengths of the two end resistors to measure 9/16" below the board. Bend these four leads through holes 0.3" toward the centerline of the board so as to secure the resistor assembly to the board. Cut off the leads of the other 10 resistors flush with the bottom of the board. Remove all spacers and masking tape.

The enclosure is a Bud-Minibox No. CU-2103-B, which measures 2-1/4" x 2-1/4" x 4". Cut the center holes for the two SO-239 coaxial connectors at the center of each end of the box. Drill two screw holes for fastening each connector on the same horizontal centerline. Remove enough paint where the connectors mount to be sure of good electrical contact. Drill eight 3/16" diameter holes in the enclosure to provide ventilation. The two mounting brackets for the board are made from No. 5 solder lugs. Use a piece of #14 copper wire to solder each pair of lugs together as, shown in Photo B. Bend the brackets 90°, as shown. Attach the connectors and brackets with 4-40 x 1/4" long screws and nuts.

Bend the two #14 leads and trim their ends, as shown in Photo B. Bend the mounting brackets to keep them away from the resistor leads. Attach the board with 4-40 x 1/4" long screws and nuts. Solder the #14 wires to the coaxial connectors, and then install the enclosure cover. Check the resistance between the connector center conductors to be sure that the resistance is close to 25 ohms. Also check the resistance between the connector shells to be

SWR Bridge	Test	Actual SWR			
	Freq. (MHz)	1.0	1.5	2.0	3.0
Bridge A	28.4	1.05	1.4	1.8	2.6 .
	7.25	1.05	1.05	2.2	3.2
Bridge B	28.4	1.3	1.3	2.4	3.1
	7.25	1.15	1.1	2.0	3.1
Bridge C	28.4	1.1	1.4	2.7	Approx. 4.0
	7.25	1.05	1.1	2.2	Approx. 4.0

Table 1. Test results for the three inexpensive SWR bridges.

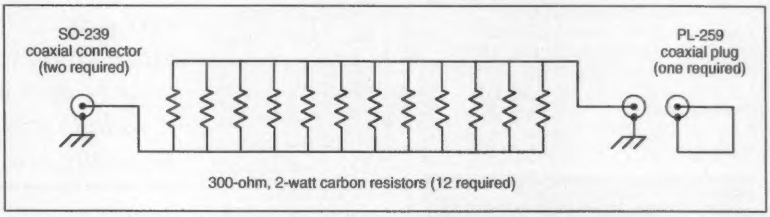


Figure 1. Schematic for the 25-ohm "add-on" load and grounding

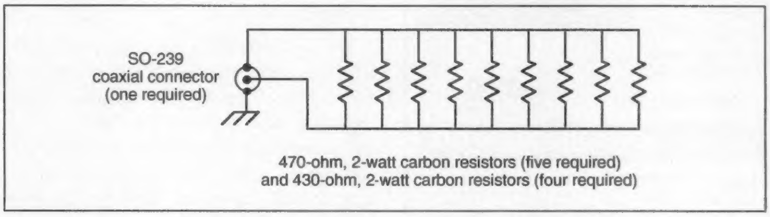


Figure 2. Schematic for the 50-ohm "add-on" load.

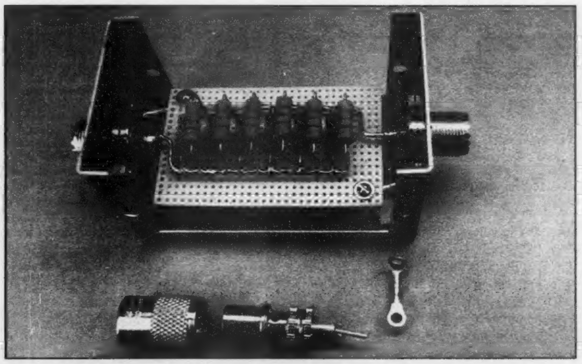


Photo B. The 25-ohm dummy load is shown with its cover removed. The grounding plug and one perfboard mounting bracket are shown in the foreground.

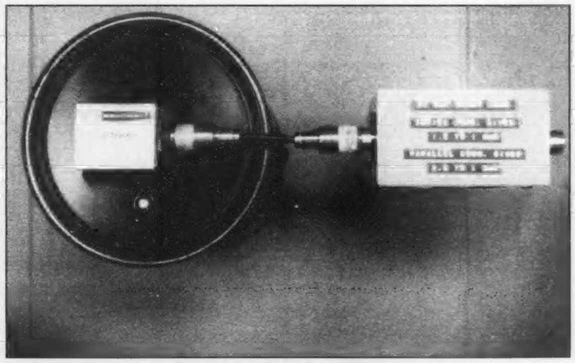


Photo C. A conventional 50-ohm dummy load, connected in series with an "add-on" load.

sure that it is close to zero.

The grounding plug is made by soldering a short piece of #14 wire between the center conductor and shell of a PL-259 coaxial plug. This is shown in Photo B before it was soldered and trimmed. Check the resistance between the center conductor and shell to be sure that it is close to zero. The schematic for the 50-ohm dummy load is shown in Figure 2. It has five 470-ohm resistors and four 430-ohm resistors in parallel. It does not have a second SO-239 connector, or a grounding plug. Otherwise, its construction is the same as the 25-ohm unit.

"Since many precautions were taken, I believe that the test results are valid, and that these bridges would perform as indicated when used normally in a ham station."

Testing

Use a relatively short length of coaxial cable between your SWR bridge and the dummy load. Bypass all other items that may now be between them. Adjust the transmitter output power to approximately 35 watts. Discontinue transmitting. Install one of the "add-on" dummy loads and proceed with testing. Photo A shows the parallel connection, and Photo C shows the series connection. Don't forget to use the grounding plug with the parallel connection. It can be attached to either end of the 25-ohm dummy load.

Test Results

The test results for three inexpensive SWR bridges are shown in Table 1. The accuracy of these bridges was not as good as had been expected. Whenever poor accuracy was evident, the test setup was checked to be sure that the resistance was the correct value, and that a good ground connection existed. The SWR meters were also checked to be sure that they zeroed properly, and that they did not have broken jewels. Since many precautions were taken, I believe that the test results are valid, and that these bridges would perform as indicated when used normally in a ham station.

Conclusion

The test results show that many inexpensive SWR bridges have poor accuracy. You should check your bridge rather than assume that it is accurate.

You can check one additional point by simply borrowing another dummy load, build either one or two "add-on" loads or a complete 2% system. The choice is yours.

When you contact our advertisers, be sure to tell them you saw their ad in *73*.

Longwave-Plus DX Techniques

Exploring the undervalued lower frequencies.

by Richard Q. Marris G2BZQ

The LF spectrum below 500 kHz is where wireless communications originated, but for many years has remained neglected by the enthusiast in favor of HF, VHF, and UHF. With the advent of so much commercial equipment for these bands, many enthusiastic experimenters have been taking a growing interest in the lower frequencies (LF, VLF, ELF) where there is a mass of interesting activity. For example, take a look at the longwave band (148.5 kHz to 283.5 kHz or 2020 to 1058 meters). For convenience, add the no man's land between the MW and LW bands (525 to 283 kHz) and, for the purpose of this article, we will call the total the longwave-plus band, which then covers 148.5 kHz (2020 meters to 525 kHz.

In Europe, N. Africa, the Middle East, and right into Asian Russia, there are AM broadcast stations. Worldwide there are numerous aeronautical/marine beacons and stations, information stations, CW traffic stations, and so forth. In North America, there is the 160–190 kHz amateur band. In the UK, there are moves to introduce an amateur band somewhere in the LF/VLF ranges.

My renewed interest in the lower frequencies commenced in the 1970s while G2BZQ/WØ in Minnesota. Having an all-band German marine portable receiver, I kept a check on the longwave band. I heard many nonbroadcast stations and beacons, which in England would often be obliterated by high-power AM broadcast stations located eastwards in Russia and south through Europe into North Africa and Turkey. Every European country appears to pump out longwave AM broadcasts right around the clock.

I was staying in Connecticut when Hurricane Bella roared northwards past Atlantic City, crossed the end of Long Island, and came across the Connecticut coast during the late evening. Hurricanes very seldom occur in England and are very tiny compared with the American variety. The Holiday Inn room was on the top floor (!), and a pitch was found, down below, at the end of the bar, where the progress of Bella could be seen on a nearby TV screen. A sporadic listening watch, with headphones, was kept on the marine portable, and I noticed that the longwave band was being seriously affected. When the "eye" of Bella was overhead, the BBC on 198 kHz suddenly appeared with rapidly increasing signal strength until it peaked at full volume. It equally rapidly disappeared as the eye moved on. Why? No answer has been offered. The antenna was a long, fat, built-in ferrite rod/coil.

Since that time, some 20 years ago, I have monitored from 150 kHz to around 525 kHz. Back in Minnesota, I made a 40" x 40" multiturn box loop and kept a sporadic watch during the long winter nights. AM BC stations were occasionally heard from Europe, plus a mass of the usual beacons and other stations throughout North America. The band abounds with activity, and what you receive depends on where you are located, the prevailing conditions, and the time of day and time of year.

To get the best from this longwave-plus band you will do best with a directional antenna and a receiver with AM, CW, USB, LSB, optional AVC, and noise limiter facilities.

The Antenna

The type of antenna used depends on the space available, but must be directional. Three simple types are described below. All are simple, easy to construct and comparatively low cost. In all cases the actual antenna is described, and the method of mounting is left to the individual. The golden rule is to use nonmetallic materials for rod/coil supports and in enclosing the variable capacitor. Also, ideally, the tuning capacitor should be mounted below the antenna with its metal body clear of the wire turns.

The "Simplex" Longwave-Plus Antenna

The frequency range of this antenna is 140 kHz to 450 kHz. Its heart is a MW/LW ferrite rod antenna as used in transistor radios, and can be purchased

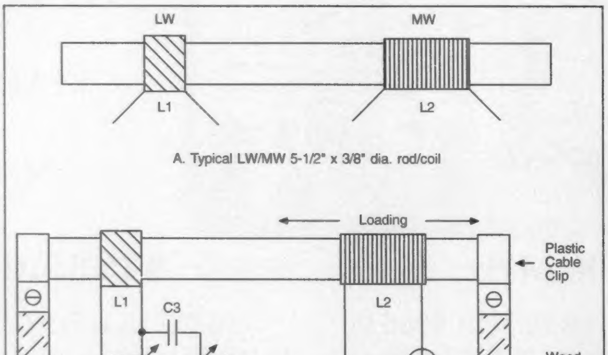


Figure 1. Typical LW/MW 5 1/2" x 3/8 dia. rod/coil.

from suppliers, or salvaged from an old transistor radio. The rod used was 5 1/2" long by 3/8" dia. (see Figure 1A), with LW (L1) and MW (L2) windings. The typical inductances were LW = 4.7 mH and MW = 370 μH. As these coils are moved towards the rod center, the inductance goes up; and when removed to the rod ends the inductance goes down. This feature is used to establish the required antenna frequency range.

The schematic (Figure 1B) shows the LW/MW rod/coil arrangement. The LW winding (L1) is moved towards the end, and the MW winding (L2) is now used for antenna coupling, to the receiver, by moving it along the rod for best coupling/matching—it can then be held in position with a spot of hot candle wax.

L1 is resonated with a 2 gang x 500 pF variable capacitor C1/C2 wired in parallel with C3 (150 pF) in series with C2. On the prototype the frequency range was 140 kHz to 450 kHz, which can be adjusted, to personal requirements, by altering the value of C3, e.g. a salvaged coil may well be a different length and diameter from the one used. The rod/coil can be plastic cable clipped to two 3/8" x 3/8" vertical hardwood, or plastic, pillars, as shown, fastened to a baseplate, with C1/C2 underneath the rod/coil.

The "Simplex" antenna will prove very effective with any receiver.

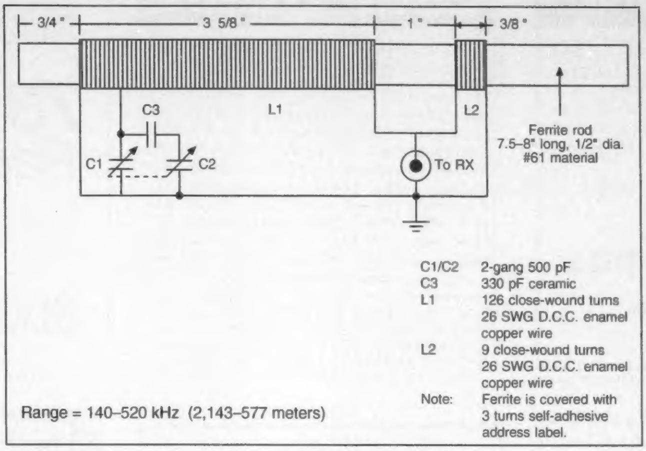


Figure 2. "The Super Ferriter"

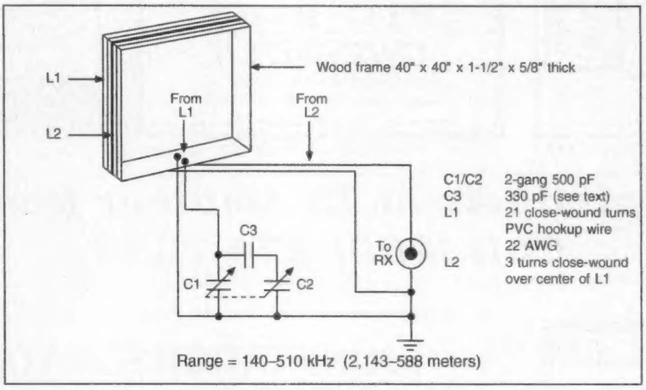


Figure 3. "The Box Loop"

Parts Lists

The "Simplex"

C1/C2	2 gang x 500 pF variable capacitor.
L1/L2	Transistor radio type ferrite rod (MW/LW) antenna, 5 1/2" x 3/8" diameter on prototype from Maplin Electronics type LB12N or similar. Or MW/LW rod/coil salvaged from old MW/LW radio. (Maplin Electronics address: P.O. Box 3, Rayleigh, Essex SS6 8LR England.)
C3	150 pF ceramic (see text).

The "Super-Ferriter"

C1/C2	2 gang x 500 pF variable capacitor.
C3	330 pF ceramic.
L1/L2	#26 SWG DCC enamel copper wire—2 ounce reel.
Ferrite rod	7 1/2" long x 1/2" diameter type R61—050- 750 OR 8" x 1/2" diameter rod fabricated from two R61—050—400 4" rods glued end to end (see text). (Amidon Associates Inc., 2216 East Gladwick Street, Dominiquez Hills CA 90220. USA).

The "Box Loop"

C1/C2	2 gang x 500 pF variable capacitors.
C3	330 pF ceramic.
Wire	PVC covered Hook-Up wire (22 AWG).

The "Super-Ferriter" Antenna

This personal favorite is a convenient small DX antenna with a frequency range of 140—520 kHz. The schematic (Figure 2) shows a high grade 7 1/2"-long x 1/2" diameter type 61 material Amidon rod. Alternatively an 8"-long 61 material rod can be fabricated from two 4" x 1/2" diameter rods stuck end-to-end with Superglue or quick setting epoxy adhesive. The rod is first covered with three layers of self-adhesive white address labels.

Two windings are shown (L1 & L2). L1 is series tuned with a combination of C1 C2 C3. L2 is the impedance matching/coupling coil giving 50 ohms matching to the receiver input. The coil windings use 26 SWG DCC Enamel Copper Wire (DCC = double cotton covered). The cotton covering effectively spaces the wire turns. The tuning and coupling circuit used give maximum RF signal output voltage to the receiver, and the "Super Ferriter" produces results normally associated with a much larger wire antenna, but with a much lower noise level—QRN & QRM.

The "Box Loop"

This Loop (Figure 3) requires a lot more domestic space than the "Super-Ferriter." The frequency range is 140 kHz to 510 kHz.

A simple wood frame is made of four lengths of 40" long x 1 1/2" wide x 5/8" thick seasoned timber. The whole is glued together as shown. Strengthening blocks can be glued inside each corner.

The main winding (L1) is 21 close-wound turns of PVC covered hook-up wire (22 AWG) around the outside of the frame. Two layers of masking tape should be wound over the center of L1. the coupling winding L2 consists of three turns of PVC covered wire close-wound over the center of L1, over the masking tape turns. L1 is tuned with C1 in parallel with C3 in series with C2. The ends of the coupling winding L2 are taken to a coaxial socket.

Operation

The above three antennas should be connected to the receiver antenna input, with a length of coaxial feed-line, which should be as short as possible. The antennas should be kept clear of the electric supply wiring and metal objects. All are directional, and should be rotated towards the received station for maximum signal and interference elimination. A simple turntable is an advantage to assist with loop rotation.

AN INVITATION FOR YOU TO JOIN THE GREEN TEAM

73, *Radio Fun*, and *"Cold Fusion"* magazines are actively recruiting more members for the lean, mean, Wayne Green team here in Peterborough. Translation: Wayne's hiring experienced and/or trainee employees.

Wayne needs an assistant technical editor now. Non-smoking ham with technical, editing and/or writing abilities would be near perfect because setting up and maintaining W2NSD's ham shack and reviewing equipment and manuscripts are some of the main responsibilities. The final focus will be a metamorphosis to Editor-in-Chief desk. Translation: Wayne wants someone capable (technically literate) to manage the magazines so W2NSD can go on more DXpeditions.

Other career opportunities abound for **MAC literate people** who know how to use Microsoft Word, Quark Xpress and/or AdobePhotoshop, **create technical drawings**, **edit manuscripts**, etc. There's a need for **circulation management** and **advertising sales** people too. Translation: **Help wanted.**

What skills do you have to offer? If you are a non-smoker and in the southern NH area, please contact Frances Hyvarian at 603-924-0058 or FAX 603-924-8613 for an interview or send detailed résumé which includes your work experiences, future ambitions, and phone number to Green Team, 73 Magazine, 70 Rte. 202 N, Peterborough, NH 03458.

73 Review

Number 10 on your Feedback card

by Steve Katz WB2WIK/6

Icom America, Inc.
2380 116th Ave. NE
Bellevue, WA 9800
(206) 454-8155
Price class:$2060

The Icom IC-738 HF Transceiver

A sturdy and popular rig.

I'm lucky enough to be frequently offered new equipment for review, and my luck was running well in early April when *73* arranged to have a new IC-738 delivered to me for this purpose.

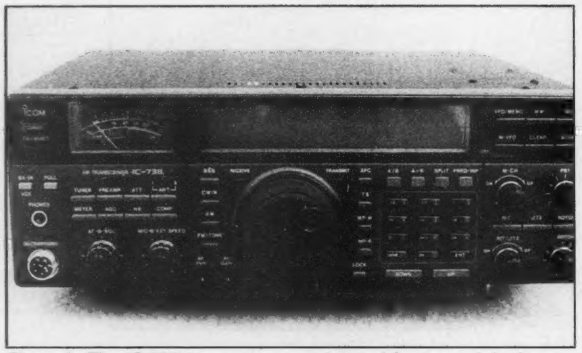


Photo A. The IC-738 has a clean, uncluttered front panel that's user-friendly with a huge main display.

The IC-738 has been on the market long enough that it's already popular, as is its more pricey sibling, the IC-736. There are only two differences between these units: The IC-736 offers 6 meter (as well as HF band) coverage and has a built-in AC power supply, while the IC-738 lacks 6 meter coverage and requires an external source of 13.8 VDC power. The two rigs share a common owner's manual and most other features. Because the IC-738 lacks an internal power supply, it weighs less (19 lbs) than the IC-736 (23.1 lbs) and may be easier to handle for field operations. As far as I can tell, the IC-736 has no provision for external DC power at all, making it a base station rig in every sense.

Despite the 738's lighter weight and potential battery-power operation, it, too, is really a base station radio because it is not small. Measuring 13" x 4.4" x 11.2" (H x W x D), the IC-738 has the look and feel of a real radio. Most of its controls are large and spaced far enough apart for even clumsy fingers, and its display is large enough to be viewed from across a large room. The Icom's 59 panel-mounted controls are easy to use, with the possible exceptions of the RF-gain and power output controls.

The IC-738 comes well-packed and includes most items needed to get on the air quickly, save for power supply and antenna. Its instruction manual is reasonably complete and well written. The transmitter output power is rated at 100 watts SSB, CW, and FM, without any note regarding possible derating requirements for high-duty-cycle operation (like FM or RTTY). I don't know whether Icom would consider it safe to operate at 100-W output continuously or not. Also, the specifications discuss only SSB, CW, FM, and AM, and don't mention the digital modes except for brief connection instructions on page 16 of the manual, which state, "The transceiver does not have an FSK mode for RTTY, AMTOR, packet, etc.; however, you can operate these using AFSK in the SSB or FM mode." I'm neither a Digital Demon nor a Binary Bimbo, but even so, I'd expect more discussion of such a popular subject.

Strengths

A point in its favor, though, is that the IC-738 passed my "Can I use this radio without opening the manual?" test with flying colors. I had the rig out of the box and on the air and completed my first 50 or so contacts, without ever glancing at the manual. And that's good. This is important because, in an emergency, there may be no time to indoctrinate operators; they need to sit in front of the radio and use it immediately. The more intuitive the rig is to operate without instructions, the better its design, as far as I'm concerned. On a scale of 1 to 10, I'd give the IC-738 a "9" for intuitive use. I'd have given it a "10," except its built-in, two-port antenna switch (front-panel controllable) kept switching to the unused port as I switched bands, making me scratch my head about why signals seemed so weak on bands where I knew they should be strong! (The IC-738 remembers which antenna position was last used on each band, and reverts to it. As it comes from the factory, who knows how it will be set up? You can override this feature, but it is not intuitive and probably requires an instruction reference.)

The first thing I noticed about the IC-738 was how uncluttered its display is. On power-up, the display panel indicates VFO frequency, mode, tuner status, VFO selection (A or B), and channel number for memory operation. That's it! I like the tidy display, and only wish it omitted the channel number unless memory operation is actually in use. It would then display only what the operator absolutely has to know. The frequency indicator numerals are large (1/2" high) and very easy to read, being dark gray segments against a bright orange background. The display is readable even operating outdoors on a sunny day.

The second thing I noticed is how quiet the receiver is. Unless the PREAMP is activated, the noise level on every band tends to indicate about "S0" (no reading) and the ambient hiss between signals is very slight. This tempts one to turn the volume up very high, to hear *something*. Then, when you tune across a signal, the sound jumps out at you from the rig's top-mounted speaker. The background noise is so low that you wonder if the receiver has the sensitivity we've come to expect from modern equipment. It does. The IC-738 tests as sensitive as any receiver I've come across. The small amount of hiss is due to advancements in synthesizer, IF, and audio stage design. The rig is deceiving. It doesn't *sound* sensitive until you need it to be, and then it's right in there with the best of them.

Weaknesses

Within a few QSOs made, I was able to find a few shortcomings with the Icom—not in performance, but in creature comforts. For example, the analog meter indicates only one of three possible data on transmit: either power output (watts scale), SWR (1 to infinity, with SWR = 3 at center scale), or ALC activity (thick "normal" range). However, there is no

way to tell which scale is active. There is no three-position panel-mounted switch to which to refer. The meter is switched by a single push-button, which toggles the meter mode between the three possibilities.

Another example is the power level control, which, like the receiver RF-gain control, is a small knobless shaft protruding through the front panel to the lower left of the main VFO tuning knob. While I don't find myself adjusting RF gain much, I do frequently like to change transmitter output power. This is a control that gets a real workout in my station, as I've never been an "AKTR" (All Knobs To Right) operator. If I work somebody very strong, I tend almost automatically to reduce my power. If the station worked is very weak, I almost automatically turn it back up. Rapid-fire contesting notwithstanding, I adjust this control a lot, and know many others who do, too. The IC-738's control for this function is too small to be easily and repeatedly adjusted.

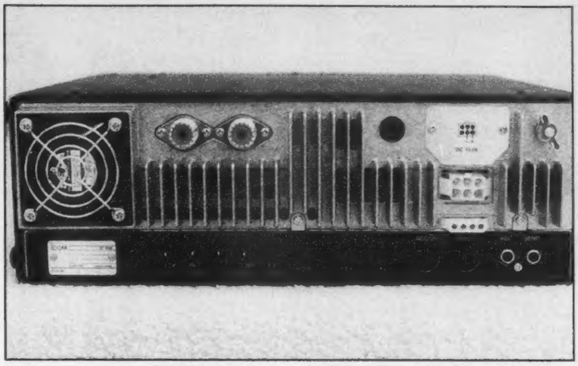


Photo B. Rear View of the IC-738. The two side-by-side SO-239 coaxial receptacles are for two antenna connections. The cooling fan to the left side of the photo is one of two cooling fans used to keep the unit loafing along even at continuous duty at full power.

One other thing that struck me as inconvenient is the placement of the VOX controls, which are on the rear panel. It is inconvenient to have to reach around behind the rig to make adjustments. In many shacks, it might take quite a bit of effort, and maybe a flashlight, to do so! VOX controls, especially the DELAY control, need to be more accessible.

My last gripe is that the IC-738 lacks transmitter mike gain. The factory-supplied, hand-held mike is quite good and sounds fine on the air, but has rather low output level and requires the 738's gain control to be run literally all the way up to make the ALC work properly.

The only other complaints I might have is that the CW sidetone level adjustment is internal and requires removing the covers. The rig has any CW offset you might want by using the ΔTx control (similar to a receive RIT, but works the transmitter offset), but the sidetone pitch always remains the same. As a true CW operator, I like being able to adjust everything I can when using this mode.

Okay, enough gripes. Other than these small issues, the IC-738 works really great!

Strengths again!

If you're already familiar with modern HF gear, you won't need any training in how to use the Icom. If this is your first modern HF transceiver, read the manual and try out each function one at a time. I like that the 738 has two key input jacks, one of them three-circuit for connection of a paddle to use the rig's (standard) internal electronic keyer, and a separate two-circuit jack for use with a straight key, "bug," external keyer, or computer control. I also like the rig's use of a common RCA "phono" jack for connecting the key line to an external linear amplifier. (Note: This jack is labeled SEND, which is a bit misleading. It is connected in common with pins on ACC[1] and ACC[2], the two accessory DIN-jacks, and is a dual-function I/O port. If grounded, as with a footswitch, the rig will transmit. If connected to the key jack of most amplifiers, it will ground on transmit and cause the amplifier to key.) I happen to *like* RCA phono plugs and jacks, mostly because they've been around for generations, are likely to be in nearly everyone's junk box, and can be picked up inexpensively at a local Radio Shack in a pinch. DINs are fine, but are also the kind of thing you might forget to bring to a DXpedition; DINs are also difficult to assemble in the field.

Operating

My first 30 or 40 QSOs with the new IC-738 were on CW, my favorite mode. (I can hear the boos and hisses, but to each his own.) The rig had no trouble producing more than 100-W output on every band. The semi-QSK worked great and so did the full-QSK (break-in) mode, up to at least 45 wpm.

On SSB, the stock microphone lacks punch unless the mike gain is turned fully clockwise. I'll guess that Icom might have a fix for that by now. I did try using one of my favorite desk mikes, an old American-made Shure 444 (big and clunky, but they usually sound good), and it produced far more punch than the stock hand-held mike and reports received were excellent. With the 444, I was able to turn the mike gain down about halfway and still have sufficient audio to get an ALC indication. The IC-738 has a built-in speech processor whose function is labeled COMP (compression) on the front panel. Its adjustment is also labeled COMP and is located on the rear apron of the radio, next to the VOX controls. The compressor worked pretty well, although stations contacted advised my audio sounded more natural with it off. This is a pretty subjective issue, and I'm used to getting mixed reports about speech processors and compressors. Despite most stations' reports telling me I sounded better with it off, the compressor did its job of increasing PEP output power as indicated on my Autek WM-1 PEP computing wattmeter. This is all one can ask for from a simple speech compressor circuit.

The rig's IF bandwidth, stated as 2.1 kHz (-6 dB), is very adequate for SSB work, but might be too wide for crowded CW operation. I liked the way the receiver sounded with the factory-equipped filter on SSB. It was tight enough to prevent much adjacent-channel interference, but wide enough to allow excellent fidelity of received signals. I thought it was just about the proper balance, and the receiver is one of the best I've ever listened to. Although I have four modern HF rigs, my standards of comparison for HF receiver performance are older equipment that in many ways outperform the latest gear. I use a 1978-vintage Drake TR-7 (transceiver) and a 1958-vintage Collins 75A4 (receiver). Believe it or not, these old-timers offer better performance under some conditions than anything built since. If a modern synthesized transceiver can hold its own against these two radios, I'm usually astounded. The IC-738 comes very close.

The IC-738 is one of the few modern HF rigs I've used having a receiver that I like listening to on SSB. I did not have at my disposal the optional narrow CW filters on the review model, so I can't comment on them. But the standard SSB filter works very well, and the optional filters are plug-in, not solder-in (although installation does require removing the radio's covers).

The 738's standard, built-in ATU (automatic antenna tuning unit) is fast and smooth as silk. I was extremely impressed with it. The ATU is activated and then implemented with a single push-button control (TUNER). A fast push activates it, and a longer push engages the tuner, which makes the transmitter operate at reduced power until the tuner finds a nearly perfect match point. I could not find any point in any band where I could not achieve a nearly perfect match with the antennas I normally use. I could even get my 6 meter vertical to load up on 80 meters, as well as achieving success with my 160 meter dipole on every single band, including 10 meters.

As an experiment, I tried loading up a 12" long Radio Shack clip lead (#20-gauge wire with an alligator clip on each end) on 20 meters. I clipped the far end of the lead to a paper poster hanging on the wall (a contest award, actually!) and the rig found a match within a few seconds. I answered a strong W5 in Arkansas, and completed a contact with the clip-lead antenna. I should note that my shack is at ground level, enclosed within the house and having no windows to the outside. This is not a very objective test, and I have no way to measure the impedance of the clip lead on 14 MHz, but it goes a long way in demonstrating the effectiveness of this tuner.

The ATU obviously has memories, and seems to know how to retune itself (once set

points have been established by prior use) as the receiver is being tuned across each band. The problem is that I don't know how many tuner memories it actually has, because the manual does not address this point. The ATU also retunes itself to the presets as one tunes around on the receiver, which makes transmitting at full power on nearly any frequency as easy as pressing the PTT button or key; but the manual does not discuss this point, either. This is a shortcoming of the manual: The rig has features that work very well but aren't even mentioned!

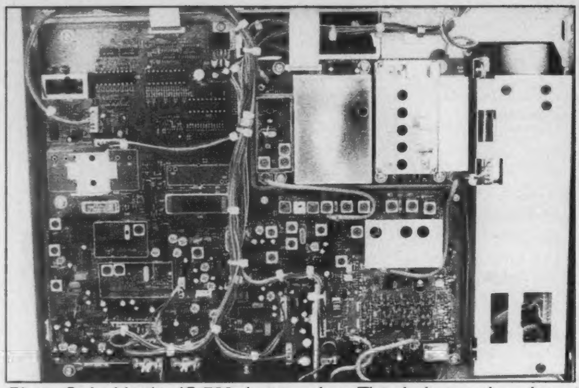


Photo C. Inside the IC-738, bottom view. The rig has a clean layout and appears easy to service. To the right, in the shielded compartment, is the ATU (automatic antenna tuning unit).

The receiver's PREAMP works well to boost receiver sensitivity on the higher bands like 10 meters, but serves no useful purpose on the noise-laden lower bands. (This is typical of many modern HF rigs. Nobody needs a preamplifier when using any reasonable transmitting antenna to receive below 10 MHz.) The IC-738 also has an ATTenuator, which reduces signals reaching the front end and might be useful when receiving on or near the frequency of extremely strong signals.

The IC-738 contains the normal complement of features and functions found in HF base station transceivers of the nineties. I've already mentioned most of the important ones, but a tour of the rig's panel controls would be incomplete without mentioning these as well.

The AGC switch is a push-button that toggles between FAST and SLOW. Although it lacks an OFF or MEDIUM mode, I found it satisfactory for most operations. The AGC performance is good. Concentric to the volume control (labeled AF) is a squelch control (SQL) that functions on all modes but is normally used only for FM work in the 29.6 MHz range. The rig has a pulse-type noise blanker activated by a push of the NB switch. It works as well as most I've used, and does a fine job of reducing ignition noise.

The built-in electronic keyer for CW work has a speed control (KEY SPEED) concentric to the mike gain (MIC) control and adjusts smoothly from 7 wpm to 41 wpm. The keyer works fine, but I usually use an external memory keyer for contest work. Still, an internal keyer is handy in a pinch or for portable work. The previously mentioned antenna switch is an internal relay that is activated by a press on the ANT button, above which are mounted two LED indicators to indicate the antenna ("1" or "2") selected. The ANTenna selection data is normally automatically stored in band memory, but may be overridden at any time by a push of the ANT button.

The RF PWR control adjusts the rig's output power from less than 5 W to full output (100 W, except on AM, where the max is about 40 W). It works well and adjusts output smoothly, but I wish it had a larger knob to make for easier frequent use. Just below the main VFO tuning knob is a tuning brake adjustment screw, turned by a small Phillips-type screwdriver, to vary tuning dial tension. I found the factory setting just about perfect, but you can adjust this to your heart's content, from quite loose (allowing a spin across the band) to fairly tight (won't jar the knob even if the rig is bumped hard).

The main VFO tuning knob operates smoothly and has a weighted feel. Large enough to provide a comfortable grip, it also has a large circular finger-hole depression for rapid motion using a single finger. I liked it a lot. This is one of those features that many hams overlook, but can make a real difference in operating, especially for long periods (like contesting). I wish every rig out there had a tuning knob like this one. Just above the tuning knob is an electronic dial lock switch (LOCK), which prohibits the VFO from changing frequency. I never actually use this function, although most modern rigs offer it.

The IC-738 offers 101 channel memories and six pages of the owner's manual are devoted to describing its operations. The memories will store frequency, offset, mode, antenna selection, and so forth. The memories can be of great assistance in a variety of ways, but I use them mostly for rapid band and mode changes, or to store repeater frequencies in the 10 meter FM subband. A very handy feature is the IC-738's scratchpad memories. These are five additional memories (extendible to 10 if desired) which do not occupy space in the normal 101 memory register, and can be instantly stored and recalled with a single push of the MP-W (Memo Pad-Write) or MP-R (Memo Pad-Read) button. If you want to store the frequency to which you're tuned, and then tune somewhere else, just punch the MP-W button and spin the knob. A single push of the MP-R button instantly recalls where you were before you tuned around. These memories stack up, and the factory default allows stacking five of them; if you add a sixth, the oldest one stored will drop out of the memory, and you'll be able to recall the latest five. This feature is very handy when DXing or contesting, and easier to use than the other 101 memories, which require more thinking and keystrokes.

Like any good, modern rig, the IC-738 has a frequency/band keypad, a set of 12 push-button switches that can be used to change bands instantly, or access specific operating frequencies without the need for spinning the VFO knob. Eleven of these buttons are labeled with band designators and/or the numbers "1" through "0," plus a decimal point. If you're on 80 meters and want to switch to 10 meters instantly, just push the "28" button, and you're there, right on the last 10 meter frequency used. If you want to dial up a specific frequency without turning the VFO knob, that's easy, too. For 14.225 MHz, you'd press FREQ INP (frequency input), followed by 1-4-.-2-2-5, followed by ENT (enter).

Another way to tune around besides using the VFO knob is to use the UP and DOWN buttons, located below the keypad just discussed. If you press and hold either button, the rig will electronically tune up or down the band in programmed steps from 1 kHz to 1 MHz. Having this function on the front panel is almost superfluous, however. The function may be duplicated with the UP and DOWN buttons atop the handheld microphone (and also found on most desk mikes). That can be handy.

Operating "split" with the 738 is as easy as with most modern rigs, and involves using the SPLIT button in combination with the A/B (VFO "A" or "B" select) button. If you wish to check your transmit frequency instantly when operating split, a push of the XFC (Transmit Frequency Check) button will toggle the VFO from the receive VFO to the transmit VFO. If you press XFC and hold it down, the VFO knob may be tuned to change your transmitter frequency to anything desired, without changing your receiver frequency. When you release the button, your transmitter frequency will be whatever was last tuned. Very handy for working split-frequency pileups.

A Quick Tuning switch (TS, for Tuning Speed) allows changing the VFO tuning speed from normal (1 Hz or 10 Hz, user-selectable) to fast (1 kHz) for rapid band excursions. When the normal (slow) tuning mode is selected to allow 1 Hz tuning, a third numeric indicator to the right of the frequency decimal point illuminates; otherwise, when the normal tuning mode is 10 Hz, this digit is blanked and not part of the frequency display. Not a bad idea. Using the 1 Hz tuning mode can be painfully slow and is rarely necessary (can you really hear a 1 Hz change?), although it might be nice when using a sharp CW filter and the NOTCH function.

The mode selector buttons are easy to use and large enough to operate quickly. Located just to the left of the main VFO tuning knob, the mode switches are labeled SSB (toggles between LSB/USB); CW/N (toggles between CW wide and CW narrow if the optional nar-

row filter is installed); AM; and FM/TONE (toggles between FM and FM+CTCSS tone [encode] if the optional UT-30 tone encoder is installed).

The IC-738, like most recent Icom products for HF, has both RIT and XIT functions. RIT, Receive Incremental Tuning, is featured under various names on all HF transceivers made in the past two decades or so. XIT allows similar adjustment of the transmitting frequency, independent of the receiving frequency. Using either one or the two together, you can work split up to about 20-kHz separation, without needing to use the SPLIT function. The RIT and XIT functions are individually addressable but share a common tuning knob labeled RIT/ΔTX.

The rig also has two interference-fighting tools: PBT (PassBand Tuning) and NOTCH filtering. The PBT control has a center off detent, while the NOTCH control has its own separate on/off switch. I found the passband tuning PBT function extremely helpful under a variety of situations, but the NOTCH not particularly useful. Notch filters are mostly intended for reducing the intensity of an interfering single-frequency carrier, and don't help much in reducing interference from a nearby SSB station. Used in combination with some patience and skill, the PBT and NOTCH can complement each other to further reduce some types of interference. But I think the PBT will be of greatest help for most users, and the one in the IC-738 is good.

The unit has the usual scanning features that may be used to frequency-scan between memories or preset band limits. The scan modes are "programmed scan," "memory scan," and "select memory scan," and are described in two pages of clear instructions within the manual.

Technically speaking

The IC-738 uses a triple-conversion receiver with "up conversion" as has become the norm. Its receive first IF is at 69 MHz, second IF at 9 MHz, and third at 455 kHz, allowing the use of conventional bandpass filters. Following the signal path from the antenna jack, received signals are first routed through the antenna switching relay, then through the T/R relay, a low-pass filter, and the receive attenuator switch before they reach either a low-pass filter for reception up to 1.6 MHz, or a set of diode-switched bandpass filters for coverage of 1.6 through 30 MHz. Seven such bandpass filters are employed, each covering an octave or less.

The filtered signals are routed to the receive preamplifier switch, where, if the preamp is engaged, they are amplified by a pair of 2SK2218 JFETs in parallel. Signals are low-pass filtered once again before reaching the first RF mixer, a pair of balanced 2SK2171 JFETs, then are bandpass filtered at the first IF of 69.0115 MHz before being amplified by the first IF amplifier, a 3SK121 dual-gate MOSFET. Received signals are then bandpass filtered once more at 69.0115 MHz before being mixed down to the 9.0115-MHz second IF in a diode balanced mixer, type ND487CIT. LO injection to both mixers is provided by the PLL unit. The first mixer injection provided by the PLL tunes from 69.0415 through 99.11499 MHz, thus allowing continuous receive coverage of nearly the entire 30-MHz spectrum. This output range is achieved by four VCOs having outputs 69.0115 MHz above the received tuning range. (For example, VCO1 produces 69.0145 through 76.0114 MHz; VCO2 produces 76.0115 through 84.0114 MHz, and so forth). The second mixer injection at 60.000 MHz is provided by a frequency-doubled 30-MHz crystal oscillator, also located in the PLL unit.

The 9.0115-MHz second IF is filtered using another 2-pole bandpass monolithic device, after which the noise blanker gate is located. The noise blanker gate is a set of four MA77 diodes driven by a gate control circuit located on the output of the noise blanker loop. The noise input to the blanker is sampled at the 9.0115-MHz IF and is amplified and detected in a noise blanker AGC loop of its own prior to driving the gate control circuit. After the diode gate, the 9-MHz IF signals are amplified once more and then bandpass filtered by one of two 9-MHz crystal filter units. (The 2.1-kHz unit is standard, but an optional narrow CW filter may be installed at this point as well. AM or FM signals continue through the

diode filter switch without filtering and go on to the third mixer, whose description follows.)

The third mixer is an integrated circuit type uPC1037HA having LO injection at about 9.4665 MHz, generated by the crystal oscillator with some frequency shift afforded by the PBT control. This mixer's output at 455 kHz is filtered by one of four diode-switched ceramic filters, three of which are standard (SSB/CW, AM, and FM) and one of which is optional (CW narrow). The 455-kHz final IF signals are postamplified by a 3SK131 DGMOSFET and then directed to either of two additional IF amplifiers (2SK882 JFETs) before reaching the appropriate detector stage for the mode selected.

The detectors used are a uPC1037HA integrated mixer/product detector for SSB and CW; a set of diodes (HSM88AS) for AM; or a MC3357DR integrated FM subsystem that acts as an IF amplifier/limiter and discriminator. Injection to the product detector is provided by a mixer (another uPC1037HA) used to provide the difference frequency of the 9.4665-MHz crystal oscillator previously discussed and a 9.0130-MHz "BFO" crystal oscillator. This difference frequency, minus the 455-kHz IF, provides an audio frequency output from the product detector. This AF output goes through the NOTCH switch and filter before being amplified by a set of cascaded 2SC4081 bipolar audio amplifiers, whose output is level adjusted by the front-panel AF (volume) control before driving another 2SC4081 and the final audio amplifier, a uPC1241H integrated audio amplifier rated at 2.6 W output.

AGC control is provided by an AGC detector driven by the last IF amplifier (455 kHz), then amplified by a 2SC4081 to control the IF amplifiers used at 69 MHz, 9 MHz, and 455 kHz. It is thus an IF-derived control loop that simultaneously adjusts the gain of all the IF amplifying stages in the receiver and is quite effective.

The circuitry is modern and well thought-out to provide a minimum of spurious or image signals. Most of the same circuitry is also used in the transmit signal path, as is typical of modern PLL-tuned transceivers. The primary differences are described below.

On transmit, the output of the 69.0115-MHz bandpass filter (already discussed in the receiver section) drives a 2SK882 JFET IF amplifier (which also provides "S" meter data to a meter amplifier) and then a balanced mixer using a pair of 3SK131 dual-gate MOSFETs, whose output is high-pass filtered to drive a 2SC4673 bipolar RF amplifier. Injection to this mixer is provided at 69.0415 to 99.11499 MHz by the PLL Unit and comes from the same set of four VCOs discussed earlier for receive injection tuning of the first RF mixer.

The output of the 2SC4673 RF amplifier is low-pass filtered and then attenuated to provide a fixed terminating load for this filter before being delivered to the PA Unit. The PA Unit contains a pre-driver (2SC1971 bipolar, operating common emitter with emitter peaking), driver (push-pull 2SC3133 bipolars, grounded emitter with adjustable base bias), and power amplifier. The final power amplifier (PA) uses a pair of push-pull 2SC2904s, grounded emitter with base bias regulation provided by a 2SD1406 series regulator.

Also located in the PA Unit is the fan control circuit, which appears to be driven by a thermostat and uses a 2SB909M bipolar fan driver. There is no discussion of how this circuit operates, and because I am unfamiliar with some of the parts used, I can't say much about it. But it does work, and the fan in my unit came on within a few minutes of transmitting at full power and kept the unit quite cool to the touch. There are actually two fans used in the IC-738 and they appear to operate in parallel.

The output of the PA is routed to the Filter Unit, a set of relay-switched (12 relays used) low-pass filters using dual pi-sections to cover each band segment (except for the 10/14-MHz LPF, which uses three pi-sections). The SWR-detector circuit, which drives the panel meter to indicate forward output power and SWR, and also provides reflected power data for the control loop that reduces the transmitter's drive in the event of a significant mismatch (as well as data for the ATU control loop), is also located in the Filter Unit, as is the two-position ("1" or "2") antenna switching relay, RL16.

The ATU is located on its own board called the Tune Unit. It uses 12 relays to switch combinations of "T"-networks to achieve the best possible match to a wide range of antenna impedances. While Icom's published specifications claim a tuning range of 16.7 to 150 Ohms (thus, it should match any antenna having a VSWR = 3 or less), I found in actual use the tuner was better than this and successfully matched a clip lead on 20 meters. (This was discussed earlier.) I also used the ATU to match rain downspouts, window screens and other ridiculous loads with amazing success. The relay-switched matching network uses fixed input and output capacitors and tuner-controlled variable capacitors across the fixed units, along with combinations of shunt "T" inductors. It's a slick system that works better than most I've used.

In most cases, the ATU can find a successful match point for reasonable antennas within just a second or two. The ATU is in the RF path only when transmitting, which is normal. (It cannot work without a signal being transmitted, and we cannot transmit a signal outside the amateur bands. Thus, the tuner would be useless for the general-coverage receiver without having some way to adjust it manually.) The tuner may be bypassed entirely with a single touch of the front-panel TUNER button. When operated in the "bypass" mode, the display screen indicates THRU. When the tuner is searching for a match, the display screen flashes a TUNE warning. When the match is found, the TUNE indicator stops flashing but remains illuminated.

Conclusions

I like the IC-738. It works very well and is easy to use. It meets its specifications with considerable margin, especially with regard to receiver performance, transmitter output power, and ATU matching range. If this were a perfect world, I'd get Icom to move the VOX controls to the front panel, make the RF power output level adjustment a larger knob, add a three-position rotary switch for meter function control on transmit, add a more readily accessible CW sidetone adjustment, and include sidetone pitch as well as volume, add more mike gain, and improve the owner's manual to more fully discuss some features and functions that are not well addressed.

As someone who has done a lot of technical writing, I'm more critical than most regarding operating manuals. And as someone who has done an awful lot of operating of amateur equipment over the past 30 years, I'm probably also more critical than most regarding control placement. After all this time, I know what I like, and no rig I've ever seen offers everything in one box. But Icom's on the right track. When all is said and done, on-the-air performance is more important than slick manuals and lots of knobs. And the IC-738 performs exceptionally well. It's a pleasure to use under most conditions, and I'll give it a thumbs up as a wise choice for a broad spectrum of users. ■

IC-738 SPECIFICATIONS

Frequency coverage:		
Receiver: 500 kHz-29.995 MHz	Actual: 30 kHz-29.999 MHz	
Transmitter: 1.8-1.9999 MHz	Actual: as published	
3.5-4.0000 MHz	3.4-4.099 MHz	
7.0-7.3000 MHz	6.9-7.499 MHz	
10.1-10.150 MHz	9.9-10.499 MHz	
14.0-14.350 MHz	13.9-14.499 MHz	
18.0-18.168 MHz	17.9-18.499 MHz	
21.0-21.450 MHz	20.9-21.499 MHz	
24.8-24.990 MHz	24.4-25.099 MHz	
28.0-29.700 MHz	28.0-29.999 MHz	
Modes: SSB, CW, AM, FM		
Number of memory channels: 101		
Antenna impedance: 50 Ohms nominal		
Usable temperature range: -10° to +60° C (14° to 140° F)		
Frequency stability: <200 Hz from 1 min. to 60 mins. after power is applied. After that, <30 Hz/hour at 25° C (77° F), and <350 Hz with temperature fluctuations from 0° to 50° C (32° to 122° F).		
Power supply requirement: 13.8 VDC ± 15% @ 20 ADC		
Current drain: 1.6 A receive (2.1 A at full audio output)		
20.0 A transmit at full power		
Dimensions: 13.0" x 4.4" x 11.2" (H x W x D)		
Weight: 19.0 lbs.		
Transmitter output power: 5-100 W	Actual: 2-120 W	
Spurious emissions: <-50 dB		
Carrier suppression: >40 dB		
Unwanted sideband suppression: >50 dB		
Microphone impedance: 600 Ohms		
Receiver sensitivity (preamp ON):		
1.8-29.995 MHz SSB, CW: <0.15 μV	Actual: <0.12 μV	(10 dB S+N/N)
28-29.7 MHz FM: <0.5 μV	Actual: <0.35 μV	(12 dB SINAD)
0.5-1.8 MHz AM: <13.0 μV	Actual: <9 μV	(10 dB S/N)
1.8-29.995 MHz AM: <2.0 μV	Actual: <1.5 μV	(10 dB S/N)
Squelch sensitivity (preamp ON):		
SSB: <5.6 μV at threshold	Actual: not measured	
FM: <0.3 μV at threshold	Actual: as published	
Spurious and image: >70 dB	Actual: >80 dB worse case	
Audio output power: >2.6 W @ 10% distortion, 8-Ohm load		
RIT/XIT range: ± 9.999 kHz	Actual: as published	

Number 11 on your Feedback card

by Michael Geier KB1UM

Sony Corporation of America
Sony Drive, Park Ridge, NJ 07656
Phone: (201) 930-1000
Price class: $479

Sony ICF-SW100S Pocket Shortwave Receiver

A Ham Station in your pocket?

Well, not quite—it doesn't transmit. Still, Sony's new ICF-SW100S pocket shortwave receiver is quite a little handful, offering advanced features never before available in such a tiny radio, including some that make the new set of interest to ham operators.

What You Get

The receiver measures 4 3/8" x 2 7/8" x 15/16", and is designed in a clamshell style, like a baby laptop computer. It looks very snazzy, and the control buttons and display are protected when you close it up. The set fits in the palm of your hand and, at 7.8 ounces (including batteries!), weighs next to nothing. It runs on two AA cells for a long time (the manual says 18 hours) or forever from the provided AC adapter.

On the lower half of the clamshell are the buttons, which include power, a numeric keypad for frequency entry, up/down tuning, timer settings and more. On the upper half are the very large display and the speaker, along with a lamp button. On the sides are jacks for the included external active antenna, stereo earphones, line out for a tape recorder, and DC power input. There's also a local/DX sensitivity switch, tone switch, and a master power switch that prevents accidental turn-ons. On the back is a good-sized telescoping whip antenna.

Along with the radio, you get an AC adapter. Curiously, the set is shipped to other countries with a self-adjusting, multivoltage adapter that can be used anywhere in the world. The U.S. version, though, operates only on 120 VAC, even though Americans are the most traveled people in the world. Go figure.

The rig comes with a nice, leather case that screws onto the back of the radio. The case opens up and lets you use the radio without removing it. Also included are a pair of earbud-type headphones, a shortwave frequency guide, and an operating manual. Finally, you get the active antenna. Unlike its predecessor, the SW-1, the SW100S gets its power from the radio, and does not require its own batteries, making it nice and light.

Photo A. The Sony ICF-SW100S Pocket Shortwave Receiver.

What It Does

So what can something this small do? Plenty! This diminutive receiver has digitally synthesized frequency coverage from 150 kHz to 29,999 MHz, plus the FM broadcast band, with FM stereo through headphones. The receiver is dual-conversion, with up-conversion on the shortwave bands for good image rejection. It has 50 memories organized into 10 pages of five memories each, and each memory can store a 6-character alphanumeric label, along with the frequency and other parameters. What other parameters? How about selectable sideband, with true SSB reception? This is not the usual "AM receiver with a BFO" style of consumer shortwave radio. This unit not only lets you pick the sideband but also has synchronous detection for AM, a valuable feature previously found only on much larger receivers.

In the AM mode, the set tunes in either 1-kHz or 5-kHz steps, using the inner and outer tuning buttons (there is no tuning knob). When you hold one of the inner buttons down, the set moves up or down so smoothly it almost seems like analog tuning; you don't hear any "tick tick tick" noise or muting as the synthesizer steps. If you press one of the outer buttons, you get 5-kHz steps. On my old SW-1, I used to like to hold the tuning button, which had only 5-kHz steps, and scan the radio manually, stopping whenever I heard something interesting go by. I liked that better than the automatic scan, which muted the set between stations. Nearly all shortwave broadcast stations are spaced at 5-kHz intervals, so it was very convenient. On the SW-100, though, holding down a 5-kHz button causes the radio to go into scan mode. Even if you keep holding it, the set stops on each active frequency, and you must let go of the button and press it again to keep it going. I prefer the old way, employing a separate scan button. Still, you can hold down the 1-kHz buttons and get the same effect, only more slowly.

In SSB mode, the inner buttons tune in 100-Hz steps, which is a little coarse by ham standards, but still gets you close enough to your desired frequency to enjoy SSB and CW without too much difficulty. The outer buttons change to 1-kHz steps, but they still have the same problem: They make the set scan if you hold them. This makes tuning in SSB awkward, because the inner buttons' 100-Hz steps are too small to get you where you're going fast enough, and the outer ones force a scan unless you press and release them over and over. I find the easiest way to get around a ham band is to go to AM mode, tune for signals with the inner buttons at 1-kHz steps, and then go to USB or LSB and fine-tune in 100-Hz steps with the same buttons.

Memories

At first, I thought that 50 memories on a pocket shortwave receiver would be overkill. How wrong I was! With the ability to store 6-character alphanumeric labels, and the organization of 10 banks of five memories each, it is very tempting to want to put all the frequencies for a particular broadcaster in one bank. Such neat organization makes it easy to find your station on any of its frequencies, but it limits you to 10 broadcasters. Oh well, complaining about having "only" 50 memories is like complaining about great pizza: You love

100KHZ TO 2060MHZ

Trident TR2400 Scanning Receiver

100KHz to 2060MHz with AM/FM/WFM/ BFO/SSB 1KHz steps

$499.00

Features 1000 memory channels, lockout on search and scan, backlighted LCD display, Attenuator, Delay, Hold, Bank lockout, VFO tuning, Signal strength meter in display. Programmable search/scan delay times. One Year Warranty., Cellular Locked out.. Size: 7.5H x 3 3/4W x 2 1/4D. Wt 14oz. Ground shipping: $6.95. Air Freight: $9.95. Call or Fax your order Toll Free, 24 hours a day.

ACE COMMUNICATIONS

Call 1-800-445-7717

10707 E. 106th Street Fishers, IN 46038
317-842-7115 Fax 1-800-448-1084

CIRCLE 164 ON READER SERVICE CARD

CABLE X-PERTS, INC.

COAX (LOW LOSS GROUP)	100FT	UP500FT
"FLEXIBLE" 9913 FOIL +95% BRAID 2.7 dB @ 400 MHz	.58/FT	.56/FT
9913 EQUAL FOIL +95% BRAID 2.7 dB @ 400 MHz	.42/FT	.40/FT
9914 EQUAL "FOAM" FOIL +95% BRAID 3.5 dB @ 400 MHz	.40/FT	.38/FT
LMR 400 DBL SHLD IIIA JACKET 2.7 dB @ 450MHz	.82/FT	.80/FT
LMR 400 *UltraFlex* DBL SHLD "TPE" JACKET 3.1dB @ 450 MHz	.75/FT	.72/FT
LMR 600 DBL SHLD IIIA JACKET 1.72dB @ 450MHz	1.47/FT	1.45/FT
LMR 900 DBL SHLD IIIA JACKET 1.10dB @ 450MHz	4.05/FT	4.00/FT
LMR 1200 DBL SHLD IIIA JACKET 0.864dB @ 450MHz	4.55/FT	4.54/FT
COAX (HF GROUP)		
RG 213/U MIL-SPEC DIRECT BURIAL JACKET 1.8dB @ 50MHz	.36/FT	.34/FT
RG8/U FOAM 95% BRD UV RESISTANT JACKET 1.2dB @ 50MHz	.32/FT	.30/FT
RG MINI 8X95% BRD BLK, SILVER, or CLEAR UV RES JKT	.15/FT	.13/FT
RG214/U (2) SILVER BRAID SHIELDS MIL-SPEC	1.30/FT	1.20/FT
RG393/U DBL SILVER SHLD "TEFLON" 25,000 W, 10MHz	4.00/FT	3.75/FT
RG142/U DEL SILVER SHLD "TEFLON"	1.10/FT	1.00/FT
RG58/U 95% BRAID	.15/FT	.13/FT
RG58A/U 95% TC BRAID	.17/FT	.15/FT
450 OHM LADDER LINE	.12/FT	.10/FT
440 OHM LADDER LINE 16GA STRANDED	.18/FT	.16/FT

COAX W/SILVER TEFLON PL259's EA END	
100FT RG213/U MIL-SPEC DIRECT BURIAL JKT 1.5dB @ 50MHz	$45.00/EA
50FT RG213/U MIL-SPEC DIRECT BURIAL JKT 1.5dB @ 50MHz	$25.00/EA
100FT RG8/U FOAM 95% BRD UV RESISTANT JKT 1.2dB @ 50MHz	$40.00/EA
50FT RG8/U FOAM 95% BRD UV RESISTANT JKT 1.2dB @ 50MHz	$22.50/EA

ROTOR CABLE	100FT	UP500FT
5971 8/COND (2/18 6/22) for runs up to: 125ft BLK UV RES JKT	.22/FT	.20/FT
4090 8/COND (2/16 6/20) for runs up to: 200ft BLK UV RES JKT	.38/FT	.36/FT
1418 8/COND (2/14 6/18) for runs up to: 300ft BLK UV RES JKT	.50/FT	.48/FT
18GA TINNED COPPER 4/C GRAY PVC JACKET	.20/FT	.18/FT
18GA TINNED COPPER 5/C GRAY PVC JACKET	.22/FT	.20/FT
18GA TINNED COPPER 7/C GRAY PVC JACKET	.26/FT	.24/FT
ANTENNA WIRE		
14GA 168 STR "SUPERFLEX" UNINSULATED	.12/FT	.10/FT
14GA 7/22 "HARD DRAWN" BC UNINSULATED	.10/FT	.08/FT
14GA SOLID "COPPERWELD" UNINSULATED	.09/FT	.07/FT
14GA SOLID "BARE COPPER" UNINSULATED	.09/FT	.07/FT
12GA 19/25 "BARE COPPER" UNINSULATED	.13/FT	.11/FT
16GA 26/30 "BARE COPPER" PVC INSULATED	.09/FT	.07/FT
14GA 41/30 "BARE COPPER" PVC INSULATED	.11/FT	.09/FT
12GA 65/30 "BARE COPPER" PVC INSULATED	.17/FT	.15/FT
DACRON ROPE DBL BRD 3/16 770# TEST	.12/FT	.10/FT
AUTOMOTIVE "ZIP" CORD		
10GA 2/C "FLEXIBLE" OIL&GAS RESISTANT RED/BLK "ZIP"	.40/FT	.38/FT
12GA 2/C "FLEXIBLE" OIL&GAS RESISTANT RED/BLK "ZIP"	.30/FT	.28/FT
18GA, 16GA & 14GA Stocked Too		

BALUNS	PRICE
W2AU 1:1 OR 4.1 1.8-40 MHZ TRANSFORMER TYPE	$21.00/EA
W2DU 1:1 1.8-30 MHZ CURRT TYPE DIPOLE OR BEAM	$23.00/EA
W2DU 1:1 1.8-30MHz "IN LINE" CURRENT BALUN	$26.00/EA
LADDER-LOC	$11.95/EA

GROUNDING BRAID				
1" TINNED COPPER BRAI	25FT $22.00	50FT $44.00	100FT $85.00	LONGER
1/2" TINNED COPPER BRAID	25FT $12.50	50FT $25.00	100FT $48.00	LENGTHS TOO

CONNECTORS		
PL 259 SILVER/TEFLON/GOLD TIP	10PKS $11.00	25 PKS $25.00
"N" CONNECTOR SILVER/GOLD TIP	10PKS $32.50	25 PKS $75.00

We install our connectors PL259 & "N" Connectors Price: $5.00/per termination (+ connnector cost)

MORE ITEMS STOCKED *CABLE & WIRE CUT TO YOUR SPECIFIC LENGTH!*

ORDERS ONLY: 800-828-3340

TECH INFO: 708-506-1886 FAX: 708-506-1970

113 McHenry Rd., Suite 240, Buffalo Grove, IL 60089-1797

For Complete Literature Mail SASE

▼ ELECTROMAGNETIC FIELD METER ▼

Reduce exposure to potentially harmful electromagnetic fields. AlphaLab's handheld TriField™ Meter measures AC electric fields, AC magnetic fields *and* radio/microwave power density. Find ground faults, AC current wires or measure high-field generators with the *Magnetic* setting (.2 – 100 milligauss, 60 Hz); identify poorly grounded or shielded equipment, high VDT or fluorescent light fields, distinguish hot vs. ground wires with *Electric* setting (.5 – 100 kV/m, 60 Hz); measure antenna radiation patterns, leaky microwave ovens, etc. on *RF/microwave* setting (50 MHz to 3 GHz, .01 to 1 mW/cm²).

Electric and magnetic settings are omnidirectional, measuring full magnitude of fields without the need to reorient the meter. Price of $145 includes delivery and one-year warranty.

AlphaLab, 1280 South 300 West, Salt Lake City, UT 84101. Call 800-769-3754 OR 801-487-9492 for speedier service or free literature on electromagnetic radiation health risks.

Mini Project Boxes

MODEL	W x D x H (IN)	PRICE $ A	PRICE $ B
MPB-1	1 x 2 x 1	1.95	2.25
MPB-2	1 x 4 x 1	2.40	2.75
MPB-3	1 x 6 x 1	2.85	3.25
MPB-4	1.5 x 2 x 1.5	2.05	2.25
MPB-5	1.5 x 4 x 1.5	2.55	2.85
MPB-6	1.5 x 6 x 1.5	3.00	3.60
MPB-7	1.5 x 2 x 3	2.25	2.55
MPB-8	1.5 x 4 x 3	2.75	3.15
MPB-9	1.5 x 6 x 3	4.00	4.50
MPB-10	1.5 x 2 x 5	2.50	3.00
MPB-11	1.5 x 4 x 5	2.95	3.55
MPB-12	1.5 x 6 x 5	4.25	5.05
MPB-13	2 x 2 x 2	2.20	2.60
MPB-14	2 x 4 x 2	2.65	3.15
MPB-15	2 x 6 x 2	4.40	5.00
MPB-16	2 x 8 x 2	6.65	7.35
MPB-17	3 x 2 x 3	2.45	2.95
MPB-18	3 x 4 x 3	2.90	3.50
MPB-19	3 x 6 x 3	4.20	4.90
MPB-20	3 x 8 x 3	4.65	5.45
MPB-21	4 x 6 x 3	4.55	5.15
MPB-22	4 x 10 x 3	4.75	5.45
MPB-23	4 x 12 x 3	5.70	6.30
MPB-24	4 x 14 x 3	6.10	6.80

PERFORATED OR PLEXIGLASS PANELS ALSO AVAILABLE

GREAT LITTLE BOXES FOR LOW COST CONSTRUCTION DESIGNED TO GET THE JOB DONE WITHOUT THE FRILLS!

0.040" BARE ALUMINUM PANELS

NEW

FOR INFO ON OTHER ENCLOSURES REQUEST *FREE* CONSTRUCTOR'S CATALOG

MENTION AD AND TAKE 5% OFF FIRST ORDER!

***ORDER TODAY!* (\$30.00 MINIMUM ORDER)**

ALL PRICES INCLUDE WORLDWIDE SHIPPING!

A IS USA, CANADA & MEXICO; B IS REST OF WORLD

SESCOM ® ORDER (800) 634-3457 ▪ FAX (800) 551-2749
(702) 565-3400 ▪ FAX (702) 565-4828
SESCOM, INC. 2100 WARD DR., HENDERSON, NV 89015
SESCOM, INC. is not responsible for inadvertent typographical errors and prices and specifications are subject to change without notice.

CIRCLE 167 ON READER SERVICE CARD

From Micro Computer Concepts

RC-1000 REPEATER CONTROLLER

- **Autopatch • Reverse Autopatch**
- **User Programmable CW ID, Control & User Codes & Timeouts**

Manual with schematics • 90-Day Warranty

Wired & Tested w/ manual **$239.95**

Micro Computer Concepts
8849 Gum Tree Ave.
New Port Richey, FL 34653

813-376-6575

CIRCLE 160 ON READER SERVICE CARD

ONV SAFETY BELT CO.
P.O. Box 404 • Ramsey, NJ 07446
800-345-5634
Phone & FAX 201-327-2462

ONV Safety Belt With Seat Harness

$89.95

OSHA

We Ship Worldwide
Order Desk Open 7 Days/Week

ONV Tool Pouch $15.95

Add $4.00 For Handling VISA M/C CHECK

ONV Belt W/O Seat Harness
$74.95

CIRCLE 102 ON READER SERVICE CARD

PCRC PERSONAL COMPUTER REPEATER CONTROLLER™

Speaks for Itself

✓ Full Duplex Autopatch
✓ 911 Emergency Access
✓ Reverse Autopatch ✓Toll Restriction
✓ Voice Mail ✓ Voice ID's ✓ BSR X10
✓Voice/Tone/DTMF Paging ✓Scheduler
✓Links ✓Programmable Courtesy Tones
✓Hardware Logic I/O ✓HF Remote Control
✓Morse Code Practice ✓Remote Base

PCRC/2 Combines the power of your XT/ATplatform with a high quality play and record voice digitizer creating the ultimate **repeater controller.**

516-563-4715 *from $695*

Fax: 563-4716 BBS: 286-1518

CIRCLE 198 ON READER SERVICE CARD

it, but you can't get enough, no matter how much they give you!

Entering the memories and their names is as easy as could be, given that there's no typewriter-style keyboard. As a bonus, if you want to move the contents from one memory to another, all you have to do is recall it, go to the other memory, and press "enter."

Clocks

As in ham radio, world time is important for shortwave listening. This radio has a versatile world clock with times for major world cities, along with their offsets from UTC. You can easily step through them to find your home QTH, or to know what time it is in Bangkok. Even better, you can rename any one of them you want, so you can change your own time zone to your city's name. Or you can replace it with your own name to prevent any confusion about who owns the radio!

Receiver Performance

With the internal whip antenna, sensitivity is pretty good, but not as hot as on some small shortwaves I've seen. Plug in the active antenna, though, and it's another story. Now the rig will hear just about anything out there. AM-mode selectivity is excellent; if you're more than 1 kHz off, you can tell. At 5 kHz off, you really can't stand it. The filtering is quite sharp for such a tiny set. Frequency accuracy is excellent; the synthesizer seems to be within about 100 Hz, which is much better than any consumer shortwave I've seen before, and approaches the accuracy of many ham rigs.

Lock On!

Synchronous detection is to AM listening what the local carrier is to SSB. In sync detection, a local oscillator is phase-locked to the incoming carrier, replacing it in the detector. Why do that? Long-distance AM signals are subject to a peculiar kind of fading distortion, caused by the fact that fading is somewhat frequency selective. The effect is that the two sidebands and the carrier do not necessarily fade together. When the carrier gets weak relative to the sidebands, the signal starts to look something like SSB, which causes a distorted mess in an AM detector. So, why not simply add in your own carrier? That'll work fine, as long as it doesn't beat against the real one. And that's why sync detectors are synced!

The Sony sync detector lets you select the sideband to which you choose to listen. It's most useful when there's an adjacent station on one side of the desired signal, but not the other (a common condition on the shortwave bands). The effect is startling. In AM, the unwanted station causes a heterodyne, or perhaps some splatter, making listening unpleasant. You press the "sync" button and the set goes to SYNC USB, syncing to the incoming station in about 1 second. If the offending signal is below your tuned station, it simply disappears! If it's above, you just press the sync button again and switch to SYNC LSB, reversing the situation.

Making a good sync detector is not as easy as it might seem. It must lock onto a wildly varying carrier, and it must stay locked through deep fades, or it'll growl as it heterodynes with the real carrier. Sony is famous for its sync detectors, but this one falls a little short of the ideal. It does a great job of removing signals on one side of the one you want, which makes it worth having, but it is less than effective against fading distortion; I couldn't tell much difference with it on or off when the signal faded significantly. And, mine tended to unlock on rapidly fading signals. Oddly, it did it on signal peaks; it held well on fades. Still, even though it isn't the greatest sync detector I've ever heard, it sure beats not having one.

SSB

As I mentioned, this radio gives you true SSB, not just a BFO. It lets you select between USB and LSB. There's very little bleedthrough from the opposite sideband, keeping QRM to a minimum. Unfortunately, the set is quite microphonic in the SSB mode. Walking with it, bumping or jarring it, or even just pressing the buttons causes a warbly effect. Thinking that my first unit was defective, I returned it and got another one. When it behaved the same way, I contacted Sony. They were very helpful, but the their final comment was that "that's just the way it is, due to the radio's size." I suspect the PLL's loop constants are too fast, causing bounce and overshoot when vibration of the coils and crystals causes a slight frequency bobble. That may help the synthesizer lock on frequency faster as you tune, but it makes for instability on SSB. After a second or so of undisturbed operation, it settles down somewhat, but it never completely clears up. Both CW and voice signals always sound a bit warbly. Can you enjoy SSB on this thing? Yes, but forget trying to decode RTTY or SSTV from it, and don't expect full-sized HF rig performance. For that matter, the receiver shows in other ways that it isn't a full-blown ham rig. Signals outside the passband cause significant AGC pumping, especially on 75 meters, and the overall selectivity on SSB isn't what you'd get from a full-sized SSB filter. Of course, that filter would probably be about the same size as Sony's entire receiver!

> ***"Still, the Sony does let you listen to the ham bands on a rig that fits in your pocket, with room to spare for a candy bar, and perhaps it is asking too much to expect it to perform like a tabletop rig."***

By the way, although the memories do store the mode, such as LSB or SYNC USB, they don't store fractional frequencies. Let's say you select 3910 LSB and then tune to 3910.6 to receive a station clearly. Now, you store all that in a memory. When you recall it, you'll be tuned to 3910, not 3910.6. It's a little inconvenient, but doesn't seriously detract from the usefulness of the rig.

The Sound

The overall audio quality isn't bad for something this size, but it's not as good as on my SW-1. The tiny, 1 5/8" speaker does a remarkable job, but there's not much audio output power, even into headphones. At more than moderate levels, voice peaks clip and distort. Compounding that situation is the overly fast AGC, which overshoots, exacerbating the fading of signals. My Sony liaison acknowledged the fast AGC, stating that the company feels it helps in some listening situations. As any ham will tell you, though, a slow AGC is nicer for most conditions. I have a very inexpensive, analog pocket shortwave that sounds significantly better than the SW-100S on rapidly fading signals, thanks to its much slower AGC that doesn't allow the receiver sensitivity to get out of phase with the fading rate. On SSB, the fast AGC makes the beginning of each word clip and pump as the '100 clamps down, having opened up too much since the last word. Still, the Sony does let you listen to the ham bands on a rig that fits in your pocket, with room to spare for a candy bar, and perhaps it is asking too much to expect it to perform like a tabletop rig.

What I Liked

The ICF-SW100S is a slick little radio with tons of features. It's easy to use, and it runs for a long time on the batteries. The memory data is nonvolatile, so you don't have to worry about keeping fresh batteries installed, as you do on the SW-1.

What I Didn't Like

The sync detector doesn't disable when you're tuning, causing all kinds of unpleasant noises unless you turn it off each time you search for new stations. It would have been easy to have it disable itself until you let go of the tuning buttons, or until the scanner found a signal.

The AGC speed and the warbly SSB were my biggest complaints. I suspect the AGC is also the cause of the sync detector's unlocking on signal peaks. If they'd slow it down and put in a little more audio oomph, this thing would be darned near ideal.

Conclusion

If you want to listen to everything under 30 MHz on a radio you can take anywhere, this is a great way to do it! The ICF-SW100S is the most advanced pocket shortwave on the market, giving you the world in the palm of your hand. There's nothing else like it.

Number 12 on your Feedback card

ASK KABOOM

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More Measuring Up

As hams, we're used to throwing terms like "frequency," "spectrum," "harmonics," "resonance," and "intermod" around on a daily basis. We know that when we press the PTT button on our radios, we're sending out electromagnetic waves at a specific frequency, with some sidebands around it that relate to our modulation. We also know we could be putting out some energy on other frequencies in the form of harmonics or (gasp!) spurs, especially if we're unlucky and have some kind of technical problem with our radios or antennas. But what does all that really mean? What, exactly, is a frequency and how does it relate to this invisible quantity called the spectrum? With such questions in mind, let's take ourselves out of the time domain and enter the odd universe of spectral thinking.

In any circuit, a voltage or current can have only one value at a time. That much seems intuitive; how can any point on a circuit have different simultaneous values? Yet, it is possible for it to *seem* as if there are multiple events happening at the same time, thanks to time-division multiplexing, which is a fancy way of saying that you can have very rapid changes that seem simultaneous to the relatively slow human nervous system.

A good analogy is music: Its sound pressure waveforms are just like voltage levels in a circuit. It makes sense that the pressure of the air arriving at your eardrums can only have one value at one time. (Of course, in the case of heavy metal music that value may be close to infinity!) After all, how can air be moving forward and backward at the same time? Yet, you can hear many instruments playing together, and it's not hard to separate them all out in your head; certainly, you can tell the difference between the drums and the guitar, or between the oboe and the trumpet. The reason is the same: Things happen fast enough for you to integrate the information over time and filter it all out, even though it arrives mixed together into one composite waveform.

Master of Your Domain

This brings up the concepts of time domain and frequency domain. Our normal way of viewing things is in the time domain. All that means is that events, such as rising and falling voltages or changing air pressures, change over time. Think of a sine wave. Imagine yourself looking through a slit in a piece of paper as a graph of the wave on another piece of paper underneath it goes by as while being pulled left to right. You see a rising and falling spot that represents the voltage as it changes over time, and that's time-domain thinking. By the way, that's how an analog-to-digital device, like the one used to encode music on a CD, works: It samples the music waveform over and over, very fast, capturing a "snapshot" of the waveform's voltage value at the instant of sampling and storing the value as a binary number. Later on, the numbers are converted back into voltages and assembled, step by step, into a very good facsimile of the original waveform. Yup, digital conversion and reconstruction are time-domain processes.

Enter Another Dimension

The frequency domain, though, is a whole other ball of wax. The easiest way to think of it is this: The frequency domain is where events that change over time are considered constant entities unto themselves, with their rate of change being their defining factor, rather than the changes themselves indicating movement! So, the sine wave is considered to be one constant thing, rather than a series of moving voltages. That makes for a different kind of graph, with up and down representing the amplitude of the sine wave taken over a period equal to at least one cycle (rather than instantaneously), and other waves of higher and lower frequencies represented to the right and left.

3-D

Notice I called the time domain a "when" and a frequency domain a "where." To think spectrally, you have to imagine in three dimensions if you want to see everything. Imagine you're looking down from above on a bunch of waves lined up *next* to each other. The time domain of this 3-D graph is from back to front; that is, the waves would be coming straight at you if you were looking at the graph as you would in the time domain. Looking exactly straight down from above, you can't really see the up and down movement of the time domain of these waves very easily. (If you angle yourself slightly, then you can see them a little better.) To your left are waves of lower frequency, with their longer time periods stretching from the back toward the front. To your right are the higher frequencies, with shorter periods. If you're having trouble seeing this in your head, get a piece of paper and try to draw a frequency-domain graph. Of course, without the third dimension of up and down, you'll have to fake the waves' amplitudes. Still, you can get a good idea of what it will all look like. See Figure 1.

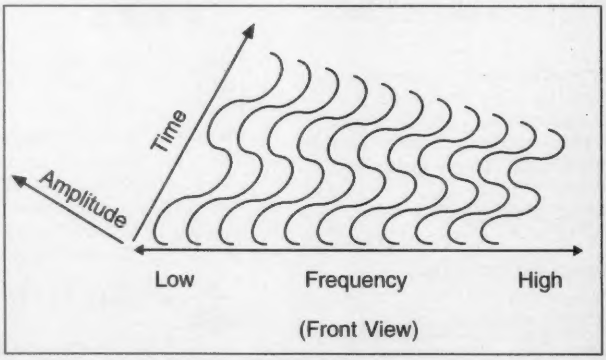


Figure 1. A frequency-domain graph.

What Are Little Signals Made Of?

We all know that signals are composed of rising and falling voltages that force corresponding currents through the resistances of circuits, be they ICs or electromagnetic field-space interfaces (now there's a fancy way to talk about a dipole, huh?). Spectrally, though, what you have are little bunches of frequency units. When you transmit a pure carrier, with no modulation, you get just one wave on the spectrum chart, with nothing to the left or right of it. When you modulate that wave, though, you start spreading out in the spectrum, thanks to the mixing of the modulation with the carrier and its effect of momentarily altering the carrier from a pure, steady sine wave. On SSB, the modulation adds and/or subtracts from the carrier frequency, depending on which sideband you use. On AM, you get mirror-image sidebands on both sides of the carrier frequency. On FM, it's quite a bit more complicated. Still, there are sidebands above and below the carrier frequency; their relationship to the modulation is not as obvious.

Harmonics

Why do a violin and a clarinet playing the same note sound so different? Their unique sonic signatures result from their waveforms, which are vastly different because of the physical structures of the instruments and their different methods of tone production.

A mathematician named Fourier created what he called "transforms" to describe the makeup of various waveforms in terms of their harmonic content. He proved that any waveform could be broken down into its fundamental frequency and its harmonic frequencies. Here's the kicker: Deconstructed in this way, *all* waveforms can be shown to be made of sine waves! Yup, even square and triangle waves. If you filter out all the frequencies above the fundamental frequency of any wave, you'll get a sine wave. It really works, both on a theoretical basis and in the real, physical world. The logical conclusion here is that sine waves themselves have no harmonics. That turns out to be true. In fact, they are the only waves having all their energy on only one frequency.

Does that mean the other

frequencies present are randomly scattered all over the spectrum? No! There's an orderly structure here, which makes sense when you consider that whatever non-sine-wave elements in a wave create, the harmonics have to recur in each cycle of the wave. That suggests the frequencies of these harmonics are multiples of the fundamental, or lowest, frequency. And that's exactly what happens.

Square waves, for instance, have only odd harmonics, meaning there's energy at three, five, and seven times the fundamental frequency, but none at two, four, and six. Triangle waves, on the other hand, have energy at *all* harmonics. So, just how far do these harmonics go? In general, most harmonics decrease in amplitude inversely to their number. So, the third harmonic of a square wave will be at 1/3 the strength, the fifth at 1/5, and so on. Of course, it's possible to have other ratios, but the resulting composite wave will then have a different shape. In the real world, the harmonics don't go on forever; all circuits have upper frequency limits. That's why square waves don't have infinitely fast rise and fall times; the lack of infinite harmonics keeps the rise and fall times finite, and the more harmonics you lop off, the slower those times get. Lop 'em all off and you're left with . . . yup, a sine wave.

Spurs

You've probably heard of this kind of emission, especially with VHF and UHF repeater installations. Spurs are considered non-harmonic energy. This suggests that their cause does not repeat with every cycle of the wave, and that's true. Spurs can be caused by oddities of circuit design or proximity to other signals resulting in mixing products that are not locked to the period of the wave. So, they can be harder to pinpoint, because you can't go looking at some convenient multiple of your carrier frequency. How do you find spurs, or for that matter, harmonics?

Magic Window

Whether or not you've used one, you're undoubtedly familiar with the oscilloscope, which is an electronic graphing machine that presents a picture of voltage over time. Does that help us here? To some degree, it can. If you see an obviously distorted waveform (in other words, anything but a sine wave), you know there is energy on some other frequency. But where? On that question, the good ol' scope fails us. We need something stronger.

It's called a spectrum analyzer. It looks much like an oscilloscope, but it presents a frequency-domain picture instead of a time-domain one, letting us see exactly where the energy lands in the spectrum. Before, though, I said that you needed a three-dimensional graph to do that. Have they invented 3-D image tubes or what?

That would be nice! So far, though, we're still stuck in the 2-D imaging world, for the most part. So, spectrum analyzers squash the time axis flat, showing you only amplitude versus frequency. You can't see the waveforms at all, but you really don't need to. All you need to know are their amplitudes and where they fall on the frequency axis. So, how do you make a measurement device actually work in the frequency domain?

Fake It

You don't! Frequency, being a combination of time and amplitude, doesn't really exist in the direct sense. Even frequency-sensitive, resonant filters really function because of the *time* it takes for the electrical energy to get from one end of the filter to the other and back again. So, to fake a frequency display, we have to go back to the time domain.

A spectrum analyzer is nothing more than an oscilloscope with a narrow bandpass filter that sweeps up the frequency spectrum in step with the beam moving horizontally across the face of the tube. The vertical movement of the beam is made to represent the amplitudes of incoming signals as their component frequencies, a la Fourier, are consecutively passed by the input. You see what appears to be a simultaneous spectrum plot, but it's really a rapidly swept, time-domain fake. You've been had, but in a very useful way.

Next time, we'll look some more at this topic. Until then, 73 de KB1UM.

Number 13 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Please Touch the Exhibits

With the new fall term almost upon us, many of us who teach will be racking our brains trying to come up with new and exciting ideas for field trips. It isn't always easy coming up with an appropriate place for my 6th-, 7th-, and 8th-grade ham radio classes to visit. Fortunately, our school is located in Staten Island, New York, which is only 20 minutes away from Manhattan. New York City, of course, has much to offer in the way of museums and other interesting facilities. The problem has always been to find a highly motivating facility that would be appropriate for the inquisitive minds of preteens. At this age, the youngsters want to get involved with things that pique their interest. This is also an age group that is not known for its long attention span.

The Liberty Science Center in Jersey City, New Jersey, is the latest answer to a science teacher's prayer. This $67 million facility is one of the nation's newest hands-on centers. It is located in Liberty State Park, just minutes from the Statue of Liberty, Ellis Island, and downtown Manhattan. The 170,000-square foot facility features two signature design elements: The Kodak OMNI Theater's geodesic globe housing the world's largest OMNIMAX Theater; and the 170-foot observation tower.

The original plans for the science center came about out of concern for the dwindling scientific literacy among many inner-city students. In 1981, the business community, members of the Research and Development Council, and many prominent, concerned citizens of the state began assembling the plans for an institution that would aid in the development of future generations of science-literate young people.

The Liberty Science Center ontains over 60,000 square feet of exhibition space on four floors, with more than 250 innovative and engaging "hands-on" exhibits, allowing visitors of all ages to experience firsthand the excitement of science and the satisfaction of individual discovery. All the electronics that control the various exhibits are encased in clear plastic for the children to examine. Even the escalator and the computer controls are covered with clear plexiglass.

There is a Health floor that includes a sensory deprivation tunnel and an ambulance for kids to walk through and examine. Many different kinds of body simulation displays are featured requiring interactive participation. The Environment floor is also fascinating. It contains a one-of-a-kind, 60-foot interactive theater showing environmentally related films where the children make choices that control the final outcome of the action.

Photo B. See sound waves interact with foam pellets to create standing waves in the Resonance Tube at Liberty Science Center.

Of greatest interest to me and the children with me was the Invention floor. One section of the floor has a separate workshop area, in which dozens of youngsters were seated working diligently on various individual projects. Several parents were involved with their kids building small motors and generators. There were also four Liberty Science Center employees who were highly visible, moving around the workshop area and offering assistance when needed. In addition to the shelves filled with circuit boards from stereo systems, television sets, and radios, the work area has many reference books and is well stocked with all kinds of tools for kids to use.

The students and I were especially impressed with the "swap" center. Youngsters can bring in old electronic components and swap them for other items they may need. First the child is asked to explain the item in detail. The LSC personnel then assign a points value to the presentation, which can be used to obtain other electronic items in the showcase. This is truly a wonderful child-oriented facility.

Photo A. Liberty Science Center is conveniently located on the Hudson River, just across from the World Trade Center.

In several designated areas on this floor live demonstrations were going on. We got to see an exciting demonstration on virtual reality the day we were there. Various computers were invitingly set up so that not a single one was vacant. I enjoyed the fact that every time a lecturer asked if there were any questions, one of my kids would inevitably ask if they planned to install an amateur radio station at the center. One of the administrators responded that they were reviewing plans for a radio station.

Professional scientists make themselves available for mentoring of students who are doing research projects at the center. Private contributions and donations from more than 100 U.S. corporations help to support the Liberty Science Center.

For any teacher who is in the tri-state area, a visit to this most unique learning center is a must. If you are a ham radio operator, be sure to leave your suggestion about the value of having a ham radio station at the location. For more information call (201) 200-1000.

ATV

Number 14 on your Feedback card

Ham Television

Bill Brown WB8ELK
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Record-Setting Band Opening

A couple of months ago I wrote about a fantastic DX opening that occurred in the Midwest last Christmas. It turns out that during that opening, a contact was made that surpassed the overland DX record mentioned in that column. The following is an account of the band opening as observed by WilburWollerman K8AEH.

P5 FOG

On the day following Christmas, Wilbur K8AEH arose early for a snack and some coffee. Contemplating whether to sleep in some more, he noticed the thick layer of fog outside. After years of chasing ATV DX on 70cm, he knew that this kind of thick fog usually meant excellent tropo conditions.

Sure enough, he saw that stations from Dayton, Cincinnati, and Indiana were already working into Michigan, Illinois, and Wisconsin. Throughout the day, P1 signals came up to P3 and soon P5 pictures were seen from stations several hundred miles away as the fog really started rolling in. Around 11 pm it was ATV bedlam on 439.25 MHz. No matter where the antenna was pointed, pictures could be seen. Snow-free images were rolling in from Pittsburgh and Wheeling to the east and from Missouri, Arkansas, Illinois, and Wisconsin to the west. There were so many stations on the air that you just couldn't work them all.

Wilbur took pictures of many of the DX contacts. Unfortunately he ran out of film in the wee hours of the morning, just as the band seemed to be peaking out! Now where do you get a roll of film at 3 am? The correct answer is *not* to wake up the XYL and ask to borrow her camera. After she rocketed off of the bed, hitting her head in the process, Wilbur very nearly ended up with her camera permanently embedded in his head!

It turned out to be worth risking his life, since he got some excellent photos of the peak of the band opening.

Record DX

Wilbur's longest contact was with Elmo Knoch K5YWL in Harrison, Arkansas. The signal strength was between P4 to P5 over an incredible 628-mile path.

Wilbur's station consisted of an 88-element J-Beam at 70 feet, a two-stage GaAsFET amplifier and a 1-kilowatt (dual 4CX250Bs) amplifier with its own video and audio modulator that was driven by a 2C39 exciter.

Elmo K5YWL was using a quad array of FO-22 antennas at 76 feet and a 100-watt Mirage amplifier. *Thanks to Wilbur Wollerman K8AEH for the above information.*

Photo A. Actual reception of Elmo K5YWL's ATV signal from Harrison, Arkansas, as seen by Wilbur K8AEH in Reynoldsburg, Ohio. Photo by K8AEH.

Photo B. Wilbur K8AE[illegible]akes the record-breaking ATV contact from his hamshack during the Ch[illegible]as band opening. Photo by K8AEH.

DX Observed from K8AEH

WJ9Z	St. Francis, WI	WB0ZJP	O'Fallon, MO
K9SM	Hillsboro, IL	N8TSM	Lansing, MI
N9AB	NW Chicago, IL	KA8VSV	Detroit, MI
W9MZH	Fort Wayne, IN	KA3FZF	Monroeville, PA
AA9IG	Peoria, IL	N8AW	Jackson, MI
KA9TGX	Lafayette, IN	W8AHY	Lansing, MI
N9LBN	Milwaukee, WI	W9LPR	Milwaukee, WI
W9NTP	Waldron, IN	WD9ASI	Chicago, IL
K5YWL	Harrison, AR	N8TBM	Lansing, MI
KA9VXS	Lafayette, IN	WA4GSS	Ashland, KY
K3IBD	Pittsburgh, PA	KA8VZV	Wheeling, WV

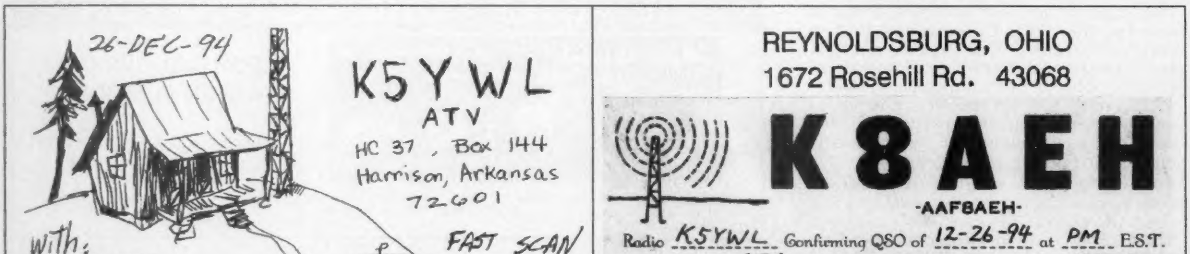


Figure 1. QSL cards confirming the record overland DX contact of 628 miles between Arkansas and Ohio.

HOMING IN

Number 15 on your Feedback card

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton, CA 92633

The T Is on! Let's Find It!

If you drive the freeways and surface streets of southern California, you're sure to see some cars, vans, and jeeps zipping along with unusual antennas on top, turning erratically back and forth. You may have encountered a group of them parked on a hilltop (see Photo A) and noticed blinking display boxes on the dashboards.

Two meter operators here are used to hearing strange beep-beep signals on 146.565 MHz simplex, and sometimes through repeaters, too. They have CW or voice identifiers giving "T numbers." On some weekends, half a dozen are on the air at a time!

As you have probably guessed, the hams with the weird mobile antennas are trying to find the sources of the weird signals. They call it "T-hunting" because they are looking for hidden Ts (transmitters). The sport is growing and spreading to large cities and small towns across the country. In some places it's traditionally called "foxhunting" and the hidden station is called the "fox." The technical name for the process is radio direction finding (RDF).

T-Hunting Basics

The idea is simple: One or two hams take a transmitter, antenna, and some sort of distinctive audio source to a carefully chosen spot, and then make continuous or intermittent transmissions. Usually the T remains stationary throughout the event, though mobile "bunnies" are allowed once in a while. The hunters, as individuals or in teams, do their best to home in on the hidden station with their mobile and portable RDF gear. Sometimes there are multiple foxes to be found in sequence. Prizes for the winners are rare; usually there is only fleeting fame, glory, and the opportunity to be hider for the next hunt.

Every team competes independently. Neither clues nor outside assistance are allowed. While the majority of southern California T-hunts are on two meter FM simplex, a few beginner-level hunts are on repeater inputs. That makes it easy for everyone to tell when the T is on the air.

Southern California is the undisputed T-hunting capital of the USA. There are over 20 competitive hunts each month. The majority start in Los Angeles and Orange counties. Monthly hunts are also available in Riverside, San Diego, and Santa Barbara counties. The latest T-hunt calendar, published by Cathy Livoni KD6CYG, shows hunts scheduled for every day of the week except Tuesday. (Hmmm . . . .)

Each monthly hunt has its own set of rules. Some are very strict, defining the number of Ts, length of transmissions, antenna polarization, boundaries, proximity to roads, time limits, and so forth. On the other hand, a few merely demand that a T be copyable at the start point or through a repeater. Just about anything else goes on these "no complaints" hunts.

Hunts are scored by one of two methods: first finder wins or low mileage wins. A few groups like timed hunts because they simulate the urgency of hunting for repeater jammers or QRM. But the vast majority prefer mileage hunts because they are more like a rally than a road race. On a mileage hunt, there is plenty of time to plot bearings carefully and plan strategy (see Photo B). Odometer-calibration differences are easily resolved because hunters obtain an odometer correction factor in advance of the hunt by driving a standard course.

The boundaries of the three monthly two meter Saturday night hunts are all different, encompassing areas ranging from 78 to 2,320 square miles. The hidden T could be 50 miles away on the Pathfinder hunt, which has the largest of the three boundaries. This hunt typically lasts from three to eight hours.

The varied terrain of southern California adds excitement and variety to T-hunting. Most hunt boundaries include flatlands of urban Los Angeles and Orange County, plus the Chino and Puente Hills, some of which are over 1,000 feet high. Other hunts include even higher mountains. With careful planning (and a little luck), the signal's characteristics will entice hunters to approach the T from the most difficult direction, with impassable roads or other obstructions, even though the T is easily reached by other routes. Sometimes the hider camouflages the setup so well that the hunters don't discover the transmitter unless they literally trip over it.

The most challenging of all are the All-Day Hunts. But that's a misnomer—a better name would be All-Weekend Hunts. They start at 10 am on the fourth and fifth Saturdays of each month. There are five types of All-Day Hunts. Rules for four of them allow the transmitter to be anywhere in the continental USA.

Hiding spots for All-Day Hunts have ranged from the banks of the Salton Sea, 228 feet below sea level, to the top of an 8,350-foot mountain peak. The distance record is currently held by Jim Forsyth AF6O and Eric Nansen N6YKE, who hid four transmitters in four states on one hunt. The farthest was in Utah, 344 miles from the Rancho Palos Verdes starting point. To provide an audible but deceptive two meter signal back to Palos Verdes, All Day Huntmasters often invent very unusual transmitting setups. For example, Jim Ford N6JF and Gordon Nichols K6KYW have used a 35-element yagi antenna with a 100-foot-long boom!

Why Big Beams?

More often than not, Los Angeles area T-hunts involve weak signals. You may have solid copy on the T from the hilltop starting point, only to have it become faint or disappear as you drive down the hill. If you start out in the wrong direction, you might not hear it again! Even if you go the right way, you could travel for many miles before acquiring the signal. For this reason, experienced southern California hunters maximize their receiving sensitivity. They prefer high gain antennas such as quads and yagis for getting their bearings.

Three- to six-element cubical quads are the most popular T-hunting beams. Usually they have a boom of wood or PVC pipe. Elements are made of thin wire (AWG 20 or 22) strung on Fiberglas spreaders in "diamond" form. Some hunters, myself included, prefer to use PVC element spreaders and heavy (AWG 10 or 12) wire formed into square elements. This design is more resistant to the dreaded "quad eating willow." When mashed by low-hanging tree branches, it is easily reshaped and returned to service, whereas thin-wire models tend to suffer wire breakage.

Yagis are a close second to cubical quads in popularity. Commercial models work fine, provided that they have a well-matched feedline, rugged construction, and good mechanical balance. Occasionally you will see some other kind of directional antenna such as a circular-element quad, a "ZL special" phased array, or a delta quad, affectionately known as a "turkey rack."

Rules usually allow transmitting any wave polarization. It is important for hunters to attempt to determine the hider's polariza-

Photo A. At sunset on a summer Saturday, southern California T-hunters gather on a hilltop to have their odometers read before the hidden transmitter comes on the air. Most have yagis or quads on rotatable masts extending through their vehicle roofs.

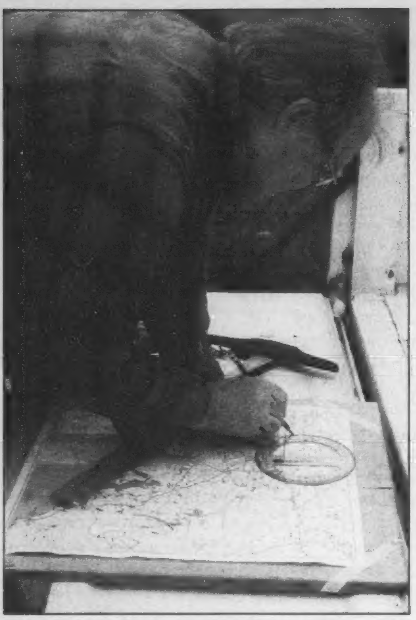


Photo B. Low-mileage-wins T-hunting encourages careful driving and meticulous plotting of bearings. John Roberts WA6LAB is getting ready to start on the Southern California Six Meter Club's monthly hunt on 50.3 MHz simplex.

Photo C. With a little thought, you can come up with a simple no-holes way to mount a rotating beam through the passenger window of almost any car. Put some sort of thrust bearing in the armrest at mast bottom for easy turning at highway speeds. Mount the beam so that a twist of the boom changes polarization.

tion and match it for receiving. A team using the wrong polarization is at an extreme disadvantage, because direct signal pickup is reduced and signal reflections (multipath) from buildings and terrain features are enhanced. Depending on circumstances, such a team may do nothing but chase reflected signals for the duration of the hunt!

Most hunters install some sort of slip joint at the beam's boom-to-mast junction. They rotate the boom to match the signal polarization at the start of the hunt, and sometimes along the way. A few builders add strings and pulleys and are able to conveniently adjust polarization from inside the car.

Doppler RDF sets have not caught on among southern California T-hunters due to their lower sensitivity, compared to beam set-ups. Vertically polarized doppler antennas are at a competitive disadvantage when the hider transmits horizontal polarization. Around here, dopplers are better suited for hunting repeater jammers, who usually use high-power and vertically polarized antennas.

Photo D. James Swenson KC6YSV figured out a clever way to mount his yagi atop the car roof without drilling a big hole. Handles at each end of the PVC pipe framework allow both driver and passenger to rotate the yagi.

For the same sensitivity and polarization reasons, switched dual-antenna RDF sets sold by companies such as BMG Engineering, Ramsey Electronics, and Radio Engineers are seldom used for mobile T-hunts in southern California. However, some teams employ them at the end of the hunt, when signals are strong, for searching out the T on foot.

Jump Right In

Isn't it great that the RDF method most suited for T-hunting on two meters is also the simplest and cheapest? This means it's easy to join in your club's T-chasing antics without a lot of work and expense. Just mount a beam antenna to your vehicle and off you go!

As a beginner, you'll do fine by lashing up a simple passenger-side, through-the-window mount that secures the mast bottom in the armrest and holds the mast center in place next to the top of the window frame (see Photo C). Why the right side? Because your state's vehicle code probably has a provision that outlaws left-side overhang. Nothing must protrude beyond the line of the fenders on the driver's side, but a few inches of overhang are permitted on the passenger side. Check to be sure.

The ideal place for a mobile RDF beam is above the center of the roof. Thus both driver and passenger can rotate it, the effect of the car's body on directional pattern is minimized, and you can use a bigger beam without worrying about overhang. If you have a sunroof, you can probably figure out a quick weatherproof holder for the mast. Some hunters have developed suction-cup mounts with belt or rod-and-crank links to go atop a vehicle (see Photo D).

The bold way, of course, is to drill a 2-inch diameter hole through the roof. Most serious hunters in southern California have overcome the objections of family members and gotten out the hole saw, as you can see from Photo A. No matter how you mount the mast, be sure to include some sort of indicator to show mast position. Straight ahead is zero degrees, dead right is 90 degrees, and so forth.

Getting a beam bearing is easy and intuitive. As you rotate your antenna, watch your receiver S meter for maximum signal indication. Carefully rotate back and forth to determine the exact peak. If the signal is too weak to view on the meter, open the receiver squelch and use your ear to detect the direction corresponding to greatest "quieting" of the noise. When you get so close that the S meter goes off scale, add RF attenuation in the feedline as necessary. Most hunters use simple resistive RF attenuators, homebuilt or bought for a few dollars at a ham radio swap meet.

T-hunters agree that you can't have too many maps. Start collecting them now; you will need them. Mount a map of the entire hunt area on a board with clear covering so you can plot and erase bearings. A good car compass is a big help in taking mobile bearings relative to true north. You can mount the compass at a slight angle on the dashboard to offset the magnetic declination (the difference between magnetic north and true north in your location). Carefully follow the compass calibration procedure to compensate for the effect of the vehicle body.

To get a true bearing (a bearing relative to true north), add the true vehicle heading to the mast indication. If the sum is greater than 360 degrees, subtract 360. For example, if you are heading down a westbound street (270 degrees) and the beam pointer reads 130 degrees, the true bearing is 40 degrees.

A few hams prefer to T-hunt alone, but most say it's much more fun to team up. The driver concentrates on handling the vehicle, while the DFer turns the beam and calculates bearings.

The DFer also handles maps and plotting (navigating), unless there is a third team member for that task.

You Gotta Sniff, Too

On most hunts, you won't be able to drive all the way until you can touch the hidden T. It may be up a tree in a park, buried on a hillside, or under groceries in a shopping cart. Searching out a T on foot is called "sniffing." Special sniffing gear is great if you have it, but you can usually find the T with just a handi-talkie and simple accessories.

The simplest way to get a bearing in the field is the "body fade." Hold your HT tight against your chest and spin around slowly, looking for the direction at which your body blocks the signal most effectively. At this point, the signal is coming from behind you. When you are so close that you can't find the signal minimum, remove the HT's antenna and try again. For even more signal reduction, use a cardboard tube about 3 feet long and 4 inches in diameter, covered with aluminum foil (leave both ends open). The more you lower the HT into the tube, the more signals are progressively attenuated.

It's not practical to use a directional antenna and ordinary resistive attenuator with a hand-held for sniffing at close range. Strong signals will penetrate the case of the HT and make it impossible to get bearings. In a pinch, you can reduce signal level by tuning the receiver 5 or 10 KHz off frequency. If you have a dual-band handheld, you get will the equivalent of 40 to 60 dB attenuation by tuning it to the third harmonic of the hunt frequency. A small UHF yagi or quad will give sharp bearings on the hidden T's third harmonic when you are within a few dozen feet.

More Toys

As you gain experience and skill, you will want to add additional gadgets to increase hunting enjoyment (and win more hunts). Early on, you'll see the need for a large easy-to-read external S meter (mechanical or LED bargraph) on the dash. Another favorite add-on is an audio S meter, so you can keep eyes on the road and yet hear signal level fluctuations.

To increase sensitivity to hear those really weak Ts, build or buy a low-noise RF preamplifier, add a noise meter to measure t he FM quieting of the signal, or a beat-frequency oscillator and single-sideband detector. For occasions when strong signals penetrate your mobile receiver's case, build an internal gain reduction system. All these projects are fully described in the 323-page book *Transmitter Hunting—Radio Direction Finding Simplified,* available from Uncle Wayne's Bookshelf.

As in any other specialty of ham radio, the more T-hunting gear you have, the more you want. But don't be intimidated by all the gizmos you see in the big vans and little jeeps of the longtime RDFers. A beam, attenuator, and good receiver is all it takes to find most Ts, and it is not unusual for a beginner to beat the "big guns." Go on a hunt and see for yourself. Bring the family; it's a great "togetherness" activity. If there are none in your area, get together with the leaders of your club and schedule one. Be prepared for some pleasant surprises. When you set out on a hunt, you never know where you'll end up, and you never know what you'll find.

Get The List

If you think it's hard to find information on T-hunting, you haven't been reading *73 Amateur Radio Today.* There has been far more on the subject here than in any other ham magazine. When answering reader inquiries, I frequently can't remember which of the 80 Homing In installments to date cover a particular RDF topic, so I put together an index of titles and subjects.

If you would like a copy of the Homing In Index, send me a self-addressed stamped envelope. My address is at the beginning of this article. If you have the capability, request the index by E-mail and I'll send it in a return message. My Internet address is HomingIn@aol.com and my CompuServe ID is 75236,2165.

While you're at it, tell me about T-hunting activities in your home town. Your photos are welcome, too. Future columns will cover unusual T-hunting customs across the country and around the world; so let's hear about yours.

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119

The Surplus Cellular Telephone—900-MHz Component Parts

Well, last month we covered HP power meters and the selection process for surplus power heads. I hope you now have all the information needed to test and evaluate used surplus power meter heads and avoid purchasing *defective* ones. I have been using the resistance check method described last month and it has worked out very well as a field evaluation test. I want you to benefit from my experiences also and so avoid the purchase of a defective unit as they can be quite costly even as a bargain. A bad or unbalanced power meter head is not a bargain if it will not function. I just don't want to see anybody purchase a bad or defective product if they can help it. After all, the dollar we spend is usually from a tight budget.

So many people have asked me how our group keeps coming up with new material all the time. Others have looked but have not had as much success as we have enjoyed. I have heard this scenario many times. The area you look in might not be as fertile for electronic scrap as the San Diego area is. Even with the large manufacturing base here in electronics, we still put forth an effort to locate used and surplus material from sources that are new and interesting.

I guess it's a little like fishing. My son is so good at fishing that he goes just for the sport of catch and release. He will tell you what type of fish he has on his line when he has 50 feet or so of line still to reel in. At that point the fish is not struggling with the line, just being tempted by the bait. He can hand the line to me and describe what to notice and I feel a dead line, and will bet on it (the first couple of times). Handing the rod back to my son, he will reel in the fish he described and collect from the old man.

Locating surplus material is similar. Kind of like putting a blood hound on the trail, but not knowing just what might turn up. In many cases it's like drilling for oil—another dry well. But a good part of the time pay dirt is struck. It's just good perseverance and sticking to the trail of good, usable items that make the chase worthwhile. You don't have to reveal how many dry wells you had to dig; you can only talk about the ones that struck pay dirt. People will think of you as a keen hunter.

Here's some real pay dirt, another surplus material idea that can pay off in short order. I am talking about the *cellular telephones* that are becoming available for almost nothing. At least that's what is happening here in San Diego. It seems that the cellular telephone companies here are offering new miniature cell phones for as little as *one percent* of full price. There is a hook: You guarantee to purchase cell phone activation and keep it active for one year of service. To make it more lucrative, you get credit for 10 minutes of air time for each month's usage. As long as you don't engage in long-winded conversations, the cost of these small new phones is such a deal that they are being snapped up faster than peanuts at a ball park. You ask what does that mean to me, the radio amateur. It means that the older briefcase-type telephones that weighed in at five pounds are being scrapped at unprecedented rates in preference to the newer, very small lightweight purse or pocket-type replacement phones.

Inside the newer type of phone you can see a very miniaturized, highly integrated circuit, almost unrecognizable as a RF transceiver for UHF operation. The newer phones are almost not worth retrieving components for amateur uses. Yet this prospect is not bleak, for the larger units are very unpopular and unwanted by the cellular companies. To the radio amateur, these larger units are just what the doctor ordered.

The larger units were constructed with discrete components and larger modules to construct the cell phone's circuitry. This large weight and older technology (discrete construction) makes a unit from which we can salvage portions of circuitry that can be used on the 902-MHz band. Now I haven't tried all the possible ideas but want to mention a few before all of these older, large phones disappear from the market.

The unit that started this train of thought was a mobile permanent trunk type of cell phone that I picked up for $1. It was missing all the interconnecting cables but the basic phone unit was intact. Upon removing the unit's case, I noticed immediately the very large PC board controller for the phone's operation. It was a circuit board about 8" X 10" long. It was stuffed with chips and other components that seemed to be very complex, but not of any great interest for our use. Apparently this unit took care of the housekeeping of the cell phone's operation and had nothing to do with the RF end other than being the processor for synthesizer control.

The other side of this cell phone was more interesting from a pure RF operation standpoint. This side contained four modules, a diplexer antenna module, a transmitter power amp module, a receiver module, and a synthesizer module. See Photo A for a graphic depiction of the circuitry involved in this part of the circuit. Because the circuitry is large, it invites our consideration for salvage operations. Taking a close look at Photo A, you can see some of the larger components, including two VCOs for 800 and 900 MHz. Also included are the standard chip set rather than miniature surface mount chips. These larger components make it very easy to recover and reuse whole circuits or individual parts. This goes for the processor on the other side of the board. I don't believe modification is in order for the processor, but component part salvage is.

For the RF side of the board, a prime PC board for intact removal is the receiver circuitry itself. Looking at the PC board with the cover plates removed, you can readily identify the RF amp, mixer, and LO inputs. I haven't tried to trace the power pins back, but with all the electrolytics and full-size standard ICs, it should be easy to back trace DC power leads. I have found many such PC boards that have lent themselves to reverse engineering for developing partial schematics of the particular PC board circuit you wish to utilize.

It's a good electronics game to sharpen your skill level on component and circuit identification. This type of operation lets those who try, to make something inexpensive into a very usable device. Sort of making a sow's ear into the proverbial silk purse. Even if the project does not realize all your ambitious plans, remember: It was obtained for very little and the most you can lose is effort. Along the way, however, you have gained quite a lot of solid technical updating by the reverse engineering process and delving into technical pubs for IC pinouts, trying to make use of the PC board you selected.

In my case, I removed the main PC board and tossed it into the component salvage pile for plain old PC boards; nothing special about this board but some parts at a later date. I removed the four RF modules and tried to make some sense out of two of the boards. First, just what does it take to make the synthesizer run and is it convertible? Or better, are there some VCO components to use in construction of another, simpler synthesizer. This is the approach I took for a 902-MHz converter to be constructed out of this heap of parts.

In regards to the receiver PC board, much of the circuitry was quite standard in design, with a basic receiver block diagram layout adapted to the PC board. This unit I removed gingerly as I believed I could make use of this unit with a minimum of conversion modifications. One great feature of this receiver unit is that the receiver subdeck is totally enclosed in its own shielded compartment. This will make its use in the 902 MHz receiver quite neat in appearance. The shielded enclosure will allow modifications to the original PC board to be covered by the shield plates, thereby retaining the shield function.

Figuring the synthesizer input and IF frequencies used should be of little difficulty, as they can be bypassed while the unit is function tested on the work bench. In place of the synthesizer, a bench signal generator will supply the local oscillator frequency during testing. A 2 meter HT will serve as the new IF for both up and down conversion. Power connections and control of the receiver now only need to be reverse engineered. While the receiver is in a mock test jig, all sorts of modifications as needed can be attached or removed from the original circuitry to bring the receiver back to life.

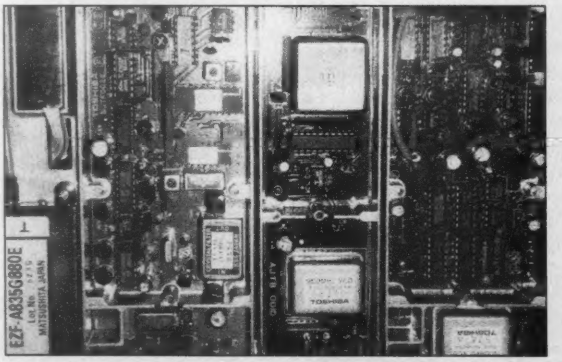


Photo A. Large-scale circuitry (relatively speaking) invites consideration for salvage.

Inasmuch as we are starting this project on a radio that has no accompanying information or schematics, this conversion will have to be an individualized task. It's not a difficult one, but rather fun-filled at reusing the quality circuitry for another amateur band, especially as these units can be obtained for little or nothing. That is what makes the appeal universal. Diligent calling around in your own part of the country will obtain you some of these larger junk cell phones. Even if you have to pay for the unit, it can't be very much. As I stated before, these larger units are a drug on the market and are not wanted.

Check out your local cellular telephone companies and retail suppliers of cell phones. Talk to the technical people, if possible. An especially important note: Make sure the cellular people know that you do not intend to use the equipment for commercial purposes, that it will not be "resurrected" on the cell network. This remark is usually enough to divert some material from the scrap heap into your modification workbench. In this light, be prepared to pick up a partially wrecked phone or one that has been disabled. Even the transmitter circuit of these phones includes a module that is capable of output powers of from 1–3 watts. This varies from model to model, but it still is a source of good components.

I studied the unit that I picked up for quite some time and determined that the units for my conversion will be the synthesizer and the receiver front end. I plan to save the other components for a later project or stocking the junk box. Don't be hasty in disposing of the remaining dregs from the cell phone; they could be put to use in other projects.

The synthesizer circuitry appears to be quite straightforward in design. My unit used a 900-MHz voltage controlled oscillator under the control of an MC-145146 synthesizer chip. Also on this same subchassis was a temperature-compensated crystal oscillator (TCXO) at 12.45 MHz. I have yet to test this module fully but, looking at the synthesizer chip, I can see that its programming lines are coupled off the board for control to the processor side of the original cell phone. My hope is that the synthesizer chip can be controlled by a dip-switch type of programming on the input synthesizer control lines. If this proves to be true after the power lines are determined for this board, it will be up and running on clip leads on the bench.

Well, I don't mean to say that clip leads will be used for everything. A point to remember when making a mock-up connection on the test bench is that lead length can be a factor in the test configuration. For DC power connections, clip leads can most certainly be used and work well. Where long leads or connections must be dressed properly or kept to a minimum is in the RF output (coaxial), and in the programming lines. If the oscillator and the RF divide by circuitry prior to coupling to the lower frequency synthesizer chip, these leads must be very short and properly dressed to maintain circuit operation.

Any attempt to use clip leads on the prescalar leads to the divide would result in a nonfunctioning circuit. What can you do? Take a look at how the circuit was originally tied together and try and maintain similar connections between the portions of the circuitry; learn by making it just like the original circuit. Anything resembling the original circuit should function reasonably well in a mock-up test configuration.

I designed a similar synthesizer many years ago, using components from a CATV control box. I used the Plessey divide-by-256 and a voltage-controlled oscillator that was regulated by a Motorola MC-145106 synthesizer chip. I intended to have a dip switch control the pull up leads on the synthesizer chip and put forth a schematic on that. The same circuit was used with the CATV tuner just a few months ago.

Back to the synthesizer chip in the cell phone: Mine was a Motorola MC-145146 (I looked up the device) and is processor controlled. That eliminates any concept of adapting a dip switch to lock the device to a usable LO frequency. I am looking at the possibility of pulling the original chip and replacing it dead-bug-style with the experimenter's special, the old MC-145106, a manual dip switch programmable synthesizer. What makes this chip suitable is the pin dip switch programming capabilities, and that I have a small quantity of them on hand.

The receiver front end I removed looked quite easy to convert to a simple down converter for 10.7 MHz, the IF frequency. The rest of the circuitry should just be removed, unless you want to trace it out for the possibility of reusing more of the circuitry. I took the easy way out by coupling the existing 10.7-MHz IF chain to an external circuit. You can put the remainder of the circuitry in the parts bin. Hey, when you pick up an old cell phone for less than a couple of bucks, there will be lots of extra parts for the junk box. In any case, there are still quite a few high-speed CMOS chips that can be smoked off with a heat gun. Hope you have fun ripping and tearing apart circuitry from your cell phone, your new source of parts for the 900-MHz band via surplus.

Mail Box

Pierre Binggeli HB9IAM of Geneva, Switzerland, is quite interested in the 1-watt power amplifier that is converted from 14 GHz to our 10-GHz band. He plans to use it for ATV at 10400 MHz. Pierre requests information on the conversion and modification details on retuning to 10 GHz. He is also looking for information on Frequency West or similar MS-740V microwave sources with modulation input.

Well, Pierre, I am sending you the conversion information and schematic details on the 1-watt poser amp. Also, I will include some schematic info on Frequency West "brick"-type frequency sources that I happen to have. I plan to cover the conversion of the 1-watt amplifier and other component parts (especially the synthesizer) in another column. There has been quite a lot of input since the last presentation, so the new information should receive the widest dissemination.

John Zima WA2OSA writes, "I have read your column in *73 Amateur Radio Today* magazine and am quite impressed with the way you make the 'art' of UHF and microwave simple to the layman. I have attempted some of your conversions with some actual success. The one I liked best was the conversion of a TVRO LNA feedhorn into a wideband amplifier. That was a painless conversion. Do you have any plans to convert a similar unit to a GOES weather converter?"

Well, John, I haven't had a plan to include such a unit, but I do see the need and will try to convert a similar TVRO LNA, or more properly a LNB/LNC, to a 1691 converter. The LNA was just a preamp while the LNB is a complete preamp mixer oscillator and IF amplifier. I will try to work out some of the details for this column next month on this conversion. I have a few ideas that look like a natural. Be on the lookout for suitable LNB TVRO converters to adapt to this mode of operation. The innards of the LNB should provide all the circuitry necessary for the 1691 converter, except for the local oscillator. More next month. Other projects include developing a very miniature 10-GHz transceiver converted from some of the newest microwave surplus just becoming available. Still working out the details and conversion information and will fill you in when it becomes complete.

As always I will be glad to answer questions on this and other similar amateur-related topics. Please send a SASE for prompt reply. 73 Chuck WB6IGP.

HAMSATS

Number 17 on your Feedback card

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston, TX 77083

Field Day Via Satellite

It was great. Activity was up on all the satellites this year. During June's Field Day weekend, the transponders were packed on the analog hamsats and the queues were full on the digital birds. The American Radio Relay League (ARRL) rules were the same as always, but modifications to the Radio Amateur Satellite Corporation (AMSAT) rules provided the impetus for many to pay attention to anything in the sky that might provide a few more points.

The ARRL rules are simple with regard to satellite activity and have not changed for many years. One satellite contact is worth 100 bonus points. Satellite contacts are viewed as a "band" like 80 or 40 meters for normal scoring. If a station worked K7TR using CW on AMSAT-OSCAR-13 Mode "S" (70 cm up and 13 cm down), a subsequent CW contact via RS-12 (15 meters up and 10 meters down) would be a "dupe." However, the rules do not reflect the reality of today's hamsats. Unlike the 80 meter band, the satellite world is constantly changing with new orbiting systems using HF frequencies up through the microwaves.

The AMSAT rules are quite different. Each satellite is considered a "band." During this year's Field Day, seven satellites were available for analog modes, and several more for digital communications. Special rules for the digital pacsats provided extra points for uploaded and downloaded Field Day greeting messages. Due to the nature of the broadcast-style packet protocol of the digital pacsats, it was possible to score points just by monitoring the downlink and collecting messages requested by other users without ever transmitting.

No limit was placed on the number of stations in use at any one Field Day location. Some groups like K7TR set up three satellite positions. One was specifically for RS-12 work while the other two covered the digital satellites and the high, elliptical-orbit hamsats like AMSAT-OSCAR-10 and A-O-13. For participants it provided an opportunity to focus on specific satellites. For observers it provided examples of different satellite-station configurations for unique modes. A station for mode K usually consists of dipoles for antennas and HF rigs. A mode S installation may use a parabolic dish to receive, a helix for transmitting, and a mix of converters in conjunction with VHF and UHF radios.

"The ARRL rules are simple with regard to satellite activity and have not changed for many years."

The N5EM Experiment

The Houston AMSAT group has made satellite activity the primary focus of their Field Day operation every year. If the HF position interferes with hamsat chasing, the HF is either shut down or moved to another band. This year was no exception, but Ed N5EM offered a new twist. He suggested doing a QRP Field Day, satellite rigs included.

The original plan was to build a large array of satellite antennas. This would give back some of the gain lost by the move from 100-watt amplifiers to attenuated, 5-watt transmitters. The antenna project wasn't ready in time for Field Day, but a pair of the large KLM antennas was made available at the last minute. Some participants felt that the task of running QRP with a normal antenna system was impossible during Field Day. Some amplifiers were brought along as back up.

Setup started late due to delays of the ferry boat from Galveston, Texas, across to Bolivar peninsula and Fort Travis Seashore Park. N5EM finally made it on the air 45 minutes after the start of the event. A-O-10 provided some difficult contacts, but the 5-watt signal was being heard.

It was soon discovered that stations that sounded too loud on the satellites were probably not hearing very well. Portable operation with noisy generators and many nearby transmitters make weak-signal satellite work difficult. Weaker stations away from the center of the transponders were better candidates for possible contacts.

Operation through A-O-13 turned out to be the best. The satellite was visible to most U.S. hams in the early hours of Sunday. Signals were good and stations were plentiful. Mode S was lightly populated, but three stations successfully copied the low-power signals from N5EM uplinked on 436 MHz and downlinked on 2400 MHz. A small Bob Myers Communications dish fit nicely in the KLM array, and worked quite well in conjunction with a German downconverter from TGN Nachrichtentechnik GmbH.

For the 9600-baud digital satellites, the low-power operation became a problem. During normal daily activity it is often difficult to get in the queue for file downloading. The 5 watts on the 2 meter uplinks for UoSAT-OSCAR-22, KitsatOSCAR-23 and -25, rarely got through during the crowded event. Many Field Day files were still downloaded with only a few successful requests for new file starts and hole fills. Uploading a complete greeting message was worse. Only one greeting file was sent and logged into the directory of a digital satellite. Yet at five points each the pursuit of downloaded and uploaded Field Day files was still worth the effort under the AMSAT rules.

The Dark Side

While many have argued for a change to the ARRL Field Day rules to acknowledge the changes in the satellite world, there is still a problem. Increased activity on the birds can be damaging to the satellites. The heavy load of continuous use can put a strain on the batteries, and as the available transponder output power is shared among the users, individual signals get weak. Some users then increase uplink power levels to get better returns, thus knocking out the QRP stations and making the transponder load-

Photo A. Ed N5EM working the low-power HF Field Day station.

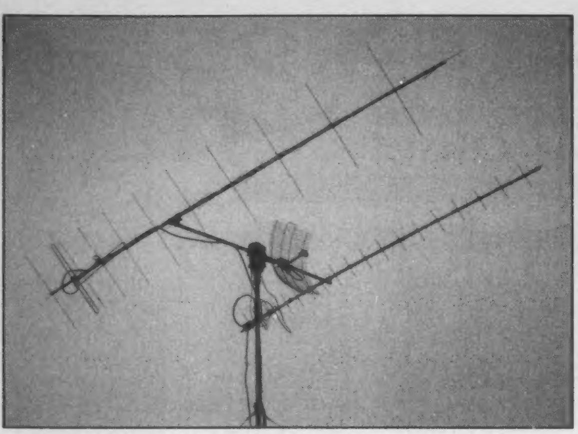


Photo B. Two large KLM crossed Yagis and a Bob Myers Mode "S" dish for Field Day satellite work.

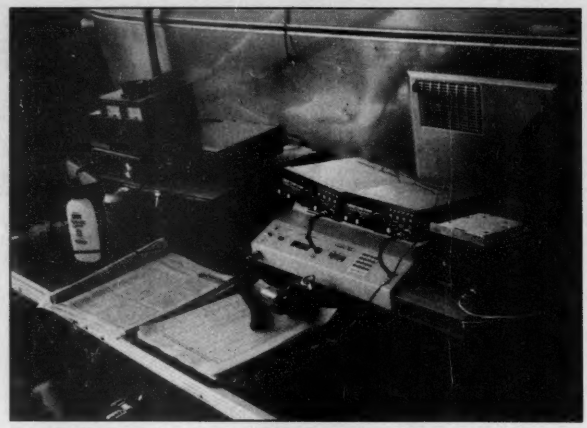


Photo C. The hamsat station at N5EM was ready for everything from Mode "K" through Mode "S," including 9600-baud digital activity.

ing even heavier. On the low-orbit RS satellites, crowding became so fierce this year that contacts were impossible for some. AMSAT rule changes next year are likely to promote QRP, but a wait-and-see attitude might be best for any ARRL modifications.

Future Field Days

Even if the high-orbit Phase 3-D satellite is launched prior to Field Day next year, it will probably not be available for contest activity. A long check-out period will be necessary, and the changes to get to the final orbit may take as long as a year after initial orbital insertion. But when the new satellite is usable for contest events, it will be fantastic. The N5EM QRP station of 1995 will be more than enough to keep up with the rest of the field. Signal levels will be at least 10 dB better on all bands. Mode S will be a common mode rather than the exotic experiment it is today, and the experimenters will be checking out their 10- and 24-GHz systems. Camera tripods with little dishes and short Yagis may be the rule for Field Days yet to come.

Don't miss all the fun! Subscribe to *Radio Fun* today by calling (800) 274-7373.

Number 18 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

A Kit-Built Low-Frequency (0–2 MHz) Sweep Generator

In a past column we looked at the Boyd Electronics (1998 Southgate Way, Grants Pass, OR 97526; 1-503-476-9583) RSG-30 high-frequency sweep generator. A sweep generator is a signal source that will sweep over a range of frequencies, rather than sit at just one frequency. It is used to test any resonant or passband circuit (indeed, any frequency-selective circuit) by displaying its bandpass characteristics on an oscilloscope.

The Boyd unit previously tested was available in kit form or ready-built, and tuned in the range 2 to 30 MHz. At the time, I wondered why there wasn't a low-frequency model. The reason is that many IF filters and other resonant or bandpass circuits operate in that area. The Boyd Electronics Model RSG-2 answers that need: It tunes from 0 to 2,000 kHz (0–2 MHz).

Boyd supplied me with a copy of their kit-built generator. Although the signal generator is also available ready-built at a somewhat higher price, I make it my policy to do the kit form in order to judge its complexity for readers. The Boyd RSG-2 (and RSG-30) can be easily constructed by anyone with ordinary electronic workbench skills—even beginners, if they follow instructions.

Figure 1 shows the "macro" block diagram for the Boyd RSG-2. It consists of two printed circuit boards. The mixer board contains a double-balanced mixer, a fixed-crystal oscillator, and a voltage-controlled oscillator (which supplies the sweeping action). The sweep board generates a sawtooth waveform and a synchronization pulse to trigger the external oscilloscope.

The sweep board also contains three controls: FREQ, SWEEP, and WIDTH. The FREQ control sets the center frequency of the sweep (or the exact frequency in the CW mode); the SWEEP control is a three-position switch that selects the CW, VIDEO, or SYMMETRICAL output modes (described below).

Figure 2 shows the internal block diagram in somewhat more detailed form. The crystal oscillator/mixer board contains five main elements: voltage-controlled oscillator, crystal oscillator, double balanced transconductance cell mixer, a low-pass filter, and an output buffer amplifier. The voltage-controlled oscillator (VCO) is a transistor variable frequency LC tuned oscillator in which the part of the capacitance that sets the frequency is set by an MV-1662 variable capacitance ("varactor") diode. Changing the voltage applied to the VCO IN point causes the frequency to change. If a sawtooth waveform is applied to VCO IN, then the frequency will sweep from a low frequency linearly up

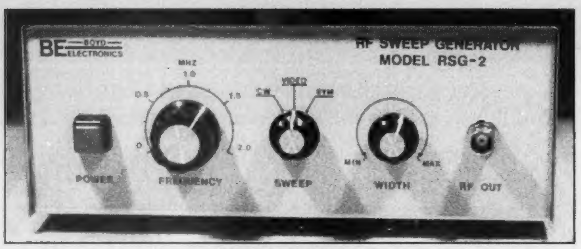


Photo A. RSG-2 as-built.

to a high frequency, and then snap back to the low-frequency end.

The crystal oscillator and mixer are provided from an NE-602 integrated circuit. The crystal oscillator is a 5-MHz oscillator that uses the NE-602 internal oscillator stage. The output of the VCO is applied to the RF input of the NE-602. The output of the NE-602 is passed through a low-pass filter that removes any signal above 2,000 kHz, and then the signal is passed to a buffer amplifier before it goes to the output.

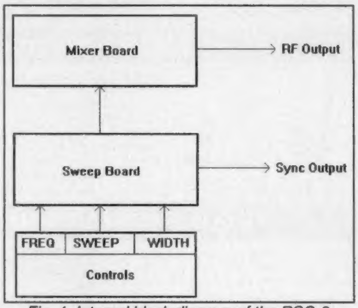


Fig. 1. Internal block diagram of the RSG-2.

RSG-2 Operating Modes

The RSG-2 sweep generator has three different output modes: Continuous Wave (CW), Video, and SYM (SYM). The continuous wave output is the same as any other RF signal generator. It produces a fixed amplitude RF signal that can be tuned over the range 0–2,000 kHz by turning the FREQUENCY knob.

The VIDEO mode sweeps from the lowest frequency to the highest frequency (0–2,000 KHz). The FREQUENCY control has no effect in this mode, and the WIDTH control only affects the highest frequencies.

The SYM mode allows the sweep to center around the frequency set by the FREQUENCY control. The WIDTH control varies the sweep magnitude about the frequency set by the FREQUENCY control. The sweep width in this mode can be set from 5 kHz to some higher bandwidth. It is the SYM mode normally used to check filters, IF amplifiers, and the like.

Construction

Like its earlier cousin the Boyd RSG-30, the RSG-2 is built inside of a Radio Shack 270–274 cabinet. Boyd offers versions of the kit with and without the cabinet so that people who want to use their own favorite cabinet are accommodated. Photo A shows the RSG-2 unit that I built, while Photo B illustrates the internal works of the project. Note that the interconnecting wires between the printed circuit boards, and between the boards and the front and rear panel components, are

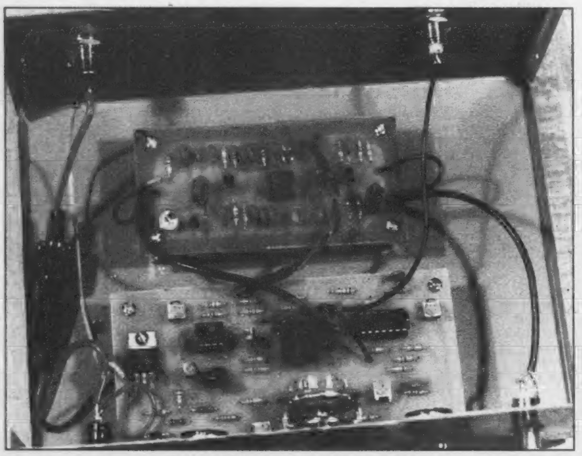


Photo B. Internal view of the RSG-2.

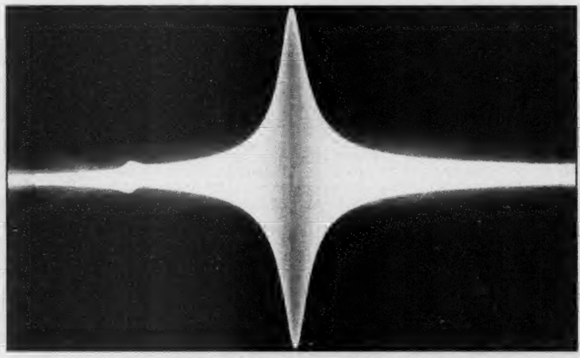


Photo C. Output waveform of the RSG-2 when passed through a 455-kHz IF transformer.

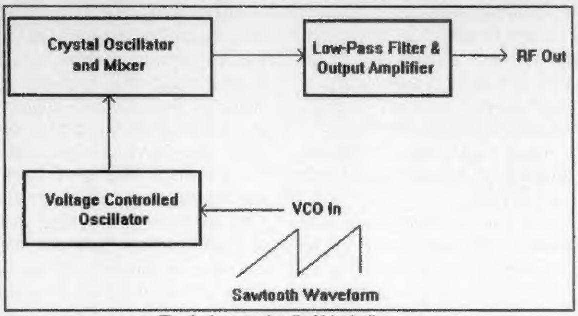


Fig. 2. A more detailed block diagram.

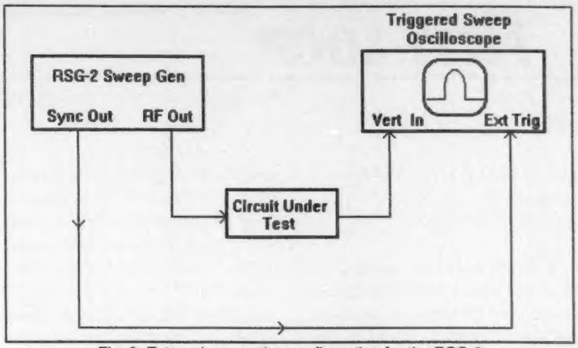


Fig. 3. External connection configuration for the RSG-2.

precut by Boyd, and so are very easily installed, even by novice builders.

Photo C shows the output waveform (this one taken using a 455-kHz IF transformer as the circuit under test). Note that it has both positive and negative peaks. In practice, the baseline would be placed at the bottom edge of the oscillocspe, so only the positive peak shows.

Connection to Circuits

Figure 3 shows the connection of the RSG-2 sweep signal generator into a usable configuration. The display unit is a triggered sweep oscilloscope. Given the low frequencies involved, nearly any old clunker of an oscilloscope will work quite well, and possesses little or no advantage over the modern 50- or 100-MHz bandwidth models currently on the market. A coaxial cable from a BNC connector on the rear panel of the RSG-2 connects the SYNC OUT to the external trigger (EXT TRIG) input of the oscilloscope. When a pulse is received at the EXT TRIG input, the 'scope will initiate a single sweep of the horizontal time base. Because repetitive pulses are sent from the RSG-2, the sweep is continuous.

The RF OUT of the RSG-2 is connected to the input of whatever circuit or device is being tested, while the output of the circuit being tested is connected to the vertical input of the oscilloscope.

My conclusion about the RSG-2 is the same as as that regarding the RSG-30 reviewed earlier in this column: It's a darn good, handy thing to have in any electronics workshop, especially a ham radio workshop where RF circuits are being tested or developed. Normally, sweep generators are beyond the means of most amateurs, but the RSG-2 and RSG-30 make them available to nearly everyone. Write to them at the address at the beginning of this column for further information about their products.

Antlers for Windows Software

If you own a Windows computer, then you might want to use the Antlers for Windows 2.00 software for calculating antenna lengths. It is available from me for $30 (P.O. Box 1099, Falls Church, VA, 22041). Comments, questions, and requests for future topics can also be directed at me at that address.

RTTY LOOP

Number 19 on your Feedback card

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21200

In most parts of the country, unless your local school district is on some kind of trimester system, September brings the return of children to school. With that joyous event always seems to come the need to respond to your questions. So, let me roll up to the keyboard, and see what's in the IN box.

Terry Perrault, R.N., WA6MVV, of Retsil, Washington, writes: "I am a retired male nurse and have been interested in RTTY since the early years, (originally) with Model 15s and 32s. I finally broke down and got into computers. Guess I am a holdout, because I still like ARC-5 gear. Anyway, I don't know what to get.

"Sure would like a hint. Don't have much money, but maybe you could give me some hints on some older but usable gear, and a source for same. Of course, in the 'old days' you built a T.U. using a 5763. Can't do that any more, I guess! I would just love to get on HF RTTY. It's been a lifelong dream, and I don't want my dream to go away."

Well, Terry, as I have stated here, before, about any transmitter and receiver that is good enough for sideband operation is good enough for HF RTTY. That means that if you have a station, use it. If not, ask around at the local ham club, radio supply store, or even Radio Shack to see if someone has an old transmitter and/or receiver to sell.

Presuming you get that far without a problem, the computer will be your next hurdle. Here, again, you don't have to go fancy. Just about all of the basic RTTY programs, such as the ones included in the RTTY Loop Software Collection, will run on a simple 8086/8088 computer. This is the basic "XT" compatible that so many computer users are dumping as they upgrade to newer and faster machines. If you ask around, you may be able to get such a machine for a song, or maybe a song and dance. Even if you went out and bought a new machine, for RTTY it does not have to be the most expensive number cruncher in the store.

All that is left is interfacing the two together, and here you have two choices. You could use a hardware interface box, such as the Kantronics KAM, AEA PK-232, or other such controller, to handle both transmitting and receiving with a minimum of software requirements. These boxes are, in essence, RTTY modems, which can run with simple communications programs on the computer or dedicated RTTY controller programs which exploit all the bells and whistles of the hardware. Alternatively, you can use a strictly software solution, where your computer does all the hard work of converting digital pulses to tones and back, using only a simple one or two chip interface to actually bridge the hardware together. One of these solutions is the popular Baycom program, which is in the Collection as well. Drop me a self-addressed, stamped envelope, or E-mail a request, for the latest listing of programs in the RTTY Loop Software Collection.

At any rate, with some frugal shopping, and especially if you have a few good friends, it shouldn't cost you much at all in the way of hard cash to get onto RTTY. Now, as to the time involved, that's a different story. At least you're retired! Let me know how things work out for you.

Yuan-Ying Chang, KE6LTH, dropped me a message over the Internet saying:

"Hi! I am a *73* magazine subscriber. I would like to thank you for providing the schematic for BAYCOM. It's very helpful for a lot of RTTY operators. I tried to build the board a few years ago, but could not find any source for the IC 3105. By the way, because I couldn't find the TCM3105, I used the AMD7910 as a replacement. It works fine, except that it needs external DC power."

I appreciate the remarks, Yuan-Ying, especially with regard to the chip substitution. I have looked around a bit in the catalogs at WA3AJR, and don't readily see the TCM3105, either. Any readers with sources are invited to put their two cents into the pot.

Hopefully, the material presented last month on using a sound card on RTTY will speak to questions received this month from Steve Carlisle VE7AHL, who expresses interest in any material in that regard; and from Phil Reid WB7OZE, who notes that the SoundBlaster sells for less than $100 in the Pacific Northwest and it has the hardware onboard, including DSP, to do the job.

As detailed last month, about all of the material I have located is for the Cardinal flavor of sound boards. For some reason, the SoundBlaster brand is not well represented here. One presumes, as detailed last month, that the programming is more straightforward on the other boards. This is not to say that it cannot, or has not, been done with the SoundBlaster, I just have not seen any of the results. Will keep at least one eye open for this one, though.

James Thomas drops a note from Taiwan, in which he says: "I was in the local bookstore and found a story written by you in *73* magazine and you were chatting about a program called XPCOM. Well, I think I have a related problem that I hope you can help me with. I just got my hands on an IC-7100, IC-R72, and CT-17 interface controller from Icom and I can't find a program in Taiwan or on the Internet that will allow me to use the Icom CT-17 to control my two Icom radios via the computer. Do you have any leads on where on the Internet I could find a program that can use the CT-17 to control the radios?"

Well, James, I looked around, and about all I found was a file detailing modifications to and features of the Icom IC-7100 receiver. You might try looking at ftp://fpt.qrz.com/mods for some of these modification files.

That URL, by the way, is the file server of the QRZ Home Page, which can be found on the world wide web at http://www.qrz.com. This is a very useful little page on the Web which, among other things, supports a rather nice set of programs, including a call book lookup. If you access your own call book entry, you can even put in an E-mail address, to facilitate users finding you. Since spots of interest on the net are rapidly becoming one of the more common requests received here, I will try to tell you about one with each new edition of RTTY Loop.

Meanwhile, I look forward to your comments and questions, as usual, by any of the common means. Feel free to drop me a line at the above address, or via E-mail on CompuServe (75036,2501), Delphi (MarcWA3AJR), America Online (MarcWA3AJR), or on the Internet (MarcWA3AJR@aol.com). Who knows, maybe a RTTY Loop Home Page will be on the Internet in the future, as well!

QRP

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

A QRP Receiver That's Easy, Simple, and Effective

I wanted to use this month to finish up some of the smaller projects for the NN1G Small Wonder Labs transceiver. But, alas, time did not permit me to get all the circuits tested. So look for those projects in the coming months.

Instead, let us look at a simple receiver for the QRPer. Just about anyone can sit down with soldier iron in hand and build a QRP transmitter. Whipping up a receiver that works is an entirely different subject. Well, there is now some good news from the folks at Ten-Tec. The Model 1056 is a direct conversion receiver you can assemble on any ham band from 160 meters to 10 meters. Best of all, all the frequency-dependent components have been included. Just pick your band and stuff the PC board with the correct capacitors and inductor.

A Closer Look

The Model 1056 is based on a simple but effective design. It also sports several novel features not normally found in simple direct conversion receivers. I'll explain these later on, but for now let's look at the audio stage of the receiver.

In a direct conversion receiver, almost all of the gain is derived by the audio stage, and the Model 1056 is no exception. However, in this case, the audio stages are fine-tuned. They produce enough gain to allow the receiver to hear weak signals, but without the distortion and microphonics that plague most direct conversion designs.

If you're accustomed to the lackluster audio from most homebrew receivers, you're in for quite a surprise. Instead of the usual QRP rig audio amplifier chip, the LM386, Ten-Tec designed the Model 1056 around a hybrid audio amplifier. The BAH packs a lot of power in a single in-line package. Ten-Tec has a history for excellent audio designs in their transceivers. No doubt, the audio amplifier stage is an off-shoot from one of their many transceivers. The Model 1056 is one of the few direct conversion receivers that can drive an external speaker with room-filling audio.

It has a PC board-mounted jack so that you can use a set of "walkthing" headphones. You can also hardwire a speaker or audio jack if you desire. The end result is the same: The Model 1056 sounds good.

Another feature you won't find in most direct conversion designs is an audio bandpass control. The bandpass is an active audio filter ahead of the audio power amplifier stage. It gives the user a small degree of control over the bandwidth of the receiver. This control works in the AUDIO section of the receiver and does not affect any of the RF stages. It seems most effective while tuning in a SSB QSO. The bandpass is not a sharp audio filter for CW. It does improve CW reception, but don't think of it as a QRM cure.

But, there are still more features found in the 1056's audio stage. You can easily inject a low-level sidetone directly into the audio stage. This is great if you're thinking about using the Model 1056 as a beginning for a single-band transceiver.

Along with sidetone injection, you can also mute the audio stage. Again, this is a slick feature for those wishing to roll their own transceiver.

The RF Side

Here the Model 1056 is rather generic. An NE602 is used as a mixer and VFO. Incoming signals are mixed inside the NE602 and then routed to the audio stages. This is classic direct conversion design.

The VFO is varactor tuned with a PC board-mounted pot. In my review unit, I had coverage from 7.000 all the way up to 7.300 MHz. The tuning is very fast. But wait! To make tuning usable, a technique from way back when is used. It's called a bandspread control. In this case, it makes tuning the band enjoyable. As the Model 1056 is designed to be played with, I would start changing values in the circuit to improve the tuning range. A 10-turn pot could easily be installed to really smooth out the bandspread.

The band on which you operate the Model 1056 will determine the components used in the VFO circuitry. There are no coils to wind. I found setting the VFO to the desired frequency easy to do with a frequency counter. Ten-Tec makes this easy to accomplish because they have included the necessary components to pick off some of the VFO's output. It's a nice touch to include in the design!

The front end includes a tuned input circuit for the band being used. A brute-force RF-gain control provides some means of controlling front-end overload.

Building the Model 1056

All components for the PC board are supplied from Ten-Tec. This includes all the components used for all the bands on which the Model 1056 will operate. You end up with a lot of extra parts and pieces when you're done! Add 'em to your junk box, or change bands when you get tired of the one you're on.

Everything mounts on one single-sided PC board. This includes the speaker jack, RF gain, main tuning, bandspread, bandpass, and volume control. The PC board has a top silk screen, but the foil side is not plated or reflow solder plated. All the PC board-mounted components fit the board, including the disc capacitors.

Assembly starts with the audio sections. You assemble the audio power amplifier and bandpass section. Then apply power to the receiver and do some simple checks. If this stage is working, you then proceed to the RF section.

The assembly manual that Ten-Tec provides gives you plenty of information on how to put the kit together. It's not overly detailed, but does use the "install part and check off" procedure. Such things as the polarity of electrolytic capacitors are clearly explained. Ditto for diodes and the ICs. It's about a clear as you can make it.

Adjustments and Alignments

Since a direct conversion receiver lacks an IF stage, the only adjustment you have to do on the Model 1056 is to set the VFO to the proper operating frequency. The best method is to use a frequency counter. If you lack one, you can press a general coverage receiver into use. Listen for the VFO and adjust it to the operating frequency desired.

With the VFO set, and providing the band you selected is open, you'll hear stations. I always choose the 40 meter band, as there is something on it 24 hours a day.

Operating Notes on the Model 1056

With such a simple circuit, it's amazing what it can hear. If I could hear it on my Argosy, the Model 1056 was able to detect it as well.

As I mentioned earlier, there's plenty of audio. This is one direct conversion receiver in which you won't have to run the audio gain all the way into its stops just to hear some band noise. The bandpass control works as it should and does help with some stations. I get the most use out of this control when listening to SSB.

The tuning and bandspread controls work together. You will do most of your tuning around the bands with the bandspread control, leaving the main tuning in one spot.

I did notice some AM bleed-through on 40 meters at night. I suspect two causes: I was using a multiband vertical antenna; and I did not reduce the RF gain. After playing with the rig for awhile, you can adjust the RF gain and audio gain controls to almost eliminate AM bleed-through. Using a single-band antenna would be a major factor in preventing out-of-band AM signals from reaching the Model 1056.

Of course I tested the rig with it just laying out on the desk. It held its own in terms of frequency stability. However, to really make it stable, it needs to be mounted in a secure enclosure. This is a *must* if you plan to use the Model 1056 on any band above 30 meters. The reason is simple. A direct conversion receiver as simple as this runs the VFO at the operating frequency. At 10 meters, the on-board VFO will be running at 28 MHz! So consider investing in a solid, all-metal box.

The Model 1056 is a great little receiver. You can't beat it for the money. It does what it says it will do and more, and would also be a great club project. The circuit provides enough features to let you listen to the world, without killing your budget. No matter if you're a seasoned QRP builder or a newcomer to the hobby, the Model 1056 will not disappoint you.

Sept '95 **Reader Service**

73 Amateur Radio Today

❑ Yes! Send me 12 issues of *73* at the low rate of $24.97. (Saves 47% off the cover price.)

Canada add $7.00 plus $1.40 GST;
Foreign add $9.00 surface; $42.00 airmail

❑ Yes! Send me 12 issues of *Radio Fun* at the low rate of $12 97. (Saves 45% off the cover price.)

Canada add $7.00 plus $.70 GST;
Foreign add $12.00 surface; $36.00 airmail

❑ Bill me ❑ Payment Enclosed

Charge my ❑ AMEX ❑ MC ❑ VISA

Card # Expires

Name (please print) Call

Address

City State Zip

This card valid until Oct 31, 1995
in the U. S. and possessions.

"You make the 73 supporting advertisers very happy when you're interested in them" ...Wayne

1	2	3	4	5	6	7	8	9	10	201	202	203	204	205	206	207	208	209	210
11	12	13	14	15	16	17	18	19	20	211	212	213	214	215	216	217	218	219	220
21	22	23	24	25	26	27	28	29	30	221	222	223	224	225	226	227	228	229	230
31	32	33	34	35	36	37	38	39	40	231	232	233	234	235	236	237	238	239	240
41	42	43	44	45	46	47	48	49	50	241	242	243	244	245	246	247	248	249	250
51	52	53	54	55	56	57	58	59	60	251	252	253	254	255	256	257	258	259	260
61	62	63	64	65	66	67	68	69	70	261	262	263	264	265	266	267	268	269	270
71	72	73	74	75	76	77	78	79	80	271	272	273	274	275	276	277	278	279	280
81	82	83	84	85	86	87	88	89	90	281	282	283	284	285	286	287	288	289	290
91	92	93	94	95	96	97	98	99	100	291	292	293	294	295	296	297	298	299	300
101	102	103	104	105	106	107	108	109	110	301	302	303	304	305	306	307	308	309	310
111	112	113	114	115	116	117	118	119	120	311	312	313	314	315	316	317	318	319	320
121	122	123	124	125	126	127	128	129	130	321	322	323	324	325	326	327	328	329	330
131	132	133	134	135	136	137	138	139	140	331	332	333	334	335	336	337	338	339	340
141	142	143	144	145	146	147	148	149	150	341	342	343	344	345	346	347	348	349	350
151	152	153	154	155	156	157	158	159	160	351	352	353	354	355	356	357	358	359	360
161	162	163	164	165	166	167	168	169	170	361	362	363	364	365	366	367	368	369	370
171	172	173	174	175	176	177	178	179	180	371	372	373	374	375	376	377	378	379	380
181	182	183	184	185	186	187	188	189	190	381	382	383	384	385	386	387	388	389	390
191	192	193	194	195	196	197	198	199	200	391	392	393	394	395	396	397	398	399	400

Where did you get this copy of 73?

999 newsstand 998 subscription

FREE INFORMATION

READER SERVICE CARD

Reader Service: To receive more information on the products advertised in this issue of 73, circle the appropriate number(s). Please allow 6 weeks for processing of inquiry. Offer valid in the U. S. and possessions.

B9509SS8-2

Place
Stamp
Here

73 Amateur
Radio Today

READER SERVICE MANAGEMENT DEPARTMENT
PO BOX 1928
RIVERTON NJ 08077-7528

ADVERTISERS

* Advertisers who have contributed to the National Advisory Committee (NIAC).

Never Say Die

Continued from page 4

Say, if you find out about anything in the health field you think I'd be interested in, send me a clipping or the name of a book you recommend I read. And I'll be reviewing some great books I've read recently for you.

Having been fat, I know all about the problem. I had a 44 waist for years. It's been 36 for the last 20 years, ever since I decided once and for all to take off the crummy fat and stay normal. I'm living proof that it can be done, so I'm not asking anyone to do something I haven't done. Another *been there, done that.* And, yes, I exercise every day, no matter where I am. There I was at 6 am jogging along the streets of Hong Kong, Beijing, Taipei, Osaka, Tokyo, Seoul, Kuching, Bangkok, Kota Kinabalu, Macao, Manila, Monaco, Paris, London, Mbabane, Maseru, Nairobi, Amman, Bahrain, and New Hampshire. The next "world" may be a great place and all that, but I intend to stick around here as long as I can . . . and do my best to keep you here with me. We can get together for a rag chew in heaven, where time runs on a different clock, and I'm not trying to get so much done in what little time I have left.

Meanwhile, there's a lot you can learn, and endless opportunities to explore and pioneer new ideas and technologies. Remember, most of the really important break-throughs in science have been made by amateurs. Or did you miss the great article in issue #1 of *73* by John Campbell W2ZGU, back in October 1960?

Good grief, I've been at this for 35 years!

Special ARRL Discounts?

A letter from Ivan N4EYQ really surprised me. He explained that as a handicapped ham he was getting a special $6-a-year membership and subscription from the League. Wow! I think that's very humanitarian of them to offer such a bargain, though it could turn out to be illegal if challenged.

Does anyone know what limitations the ARRL has put on this special rate? To what handicaps do they apply? Ivan is legally blind (20/200 or worse), but it seems to me this subscription rate would probably apply to hearing-impaired hams, too. We've had some mover-and-shaker hearing-impaired hams. Bob Weitbrecht W6NRM comes to mind. He and I made the first coast-to-coast 80m RTTY contact one night awhile back. We also worked on 11m, back before our lack of use of the band prompted the FCC to turn it into a CB band. Well, I warned everyone at the time in my editorials, but I just got called a doom and gloomer. I got the same from the old-timers when I warned that we could lose part of 220 if we didn't use it. I've still got some "220—use it or lose it" buttons I was distributing at the time.

We've had some wonderful contributions to the hobby by blind hams. I'll never forget Stan W2ER, who built and serviced all his own equipment. Or Bob Gunderson W2JIO, who published the Braille Technical Press for years.

But how about hams on welfare or unemploment compensation (job-challenged)? How about the substance-abuse disadvantaged (drug addicts)? How about our poor old seniors trying desperately to get along on their social security pittance (age-challenged)? Or is it social insecurity these days? How about our disabled military veterans? How about all of our physically challenged hams?

For that matter, how about poor old Uncle Wayne? No, I'm not blind, but I am disadvantaged and multi-challenged. I'm struggling to get along on my social security and a veteran's disability pension. I'm too old and decrepit for anyone to consider hiring me any more. Shouldn't I qualify?

Repent! The End of the World Is Near!

Fasten your seat belt. This is going to be a direct attack on contests. Yes, I recognize that I'm getting into a theological discussion. I suspect that the prefix "theo" means "il" or "non," because as soon as religion gets involved, logic has little more to do with things. Or reason.

Okay, now let's make at least an attempt to put on your thinking cap. Now, doing your very best to think, what is by far the biggest contest in amateur radio? I remember one ham (the last I heard he's in prison) who bragged that he was making over $50,000 a year in completely untaxed income just by cheating at this contest. I checked on this myself in several countries and I don't think he was exaggerating.

What one contest has forced more hams off the air than all the rest of 'em combined? What contest has generated more anger and resentment with US hams by foreign hams than all the others combined? Either you know the answer or you need to get your thinking cap refurbished.

One more chance: what contest requires the greatest investment in ham equipment just to participate?

Of course I'm talking about the ARRL's DXCC contest and their accursed Honor Roll listings.

Whenever I visit a relatively rare country, I find the local hams furious over what this has done to them. Every time they get on the air they are besieged for 15-second contacts and a QSL. Now you may think it's fun to sit and fill out thousands of QSLs every month, particularly if you have to look up each contact in your log to check it. That's when you find that a surprising percentage of US hams have no idea of what GMT is, and many have apparently even lost track of the date.

Only by calling stations who have called CQ, and by giving their own call a minimum of times, can they manage to make any real contacts. As soon as the word gets around the 2m DX-chasing nets, they are bludgeoned into contest-type operation or, as is more usual, forced off the air.

When I'm going to be visiting a rare country, I ask a local ham if I can use his station and promise to take care of the QSLs I generate. They know that this will tend to ease the pressures for him in the long run, so I've never had anyone refuse. It really isn't fun for a DX ham to be stuck with endless contest-type contacts. It's difficult enough in many of these countries to get a ticket, and then getting the rig is even harder. And after all that, the hams won't let you have a decent conversation because they "need a new country for DXCC."

When I first went to Jordan, my main aim was to work as many DXers as I could so that His Majesty would have a little less pressure to just give signal reports and send a QSL card. I spent a couple weeks working the pileups from his Summer Palace, just outside of Amman. I worked thousands upon thousands.

I've done the same thing from dozens of other rare spots. Well, it was fun for me, but if I were living there, I know it would get old. For that matter, I guess it's gotten old for me. My last real DXpedition was several years ago to St. Pierre. More recently, when I visited 11 Caribbean islands, I didn't bother to take a rig or arrange to borrow one. I did get on the air from a few islands, but only for a few contacts. Mostly around the Caribbean.

Basis And Purpose

So, if we're not going to be needed for emergency communications, and hams no longer are of the slightest interest to the military in case of war, what might be our new reason for having the use of billions of dollars of spectrum? Yes, it's a wonderful way for retired old white men to spend the time during which they aren't playing golf. But is that of more value to the country than leasing our ham spectrum to commercial companies and using the revenue to retire the national debt?

I'm proposing as a new basis for the hobby a goal of using it as a way to make high-tech careers more interesting for our youngsters. It sure worked in Jordan, where I was able to introduce that concept. It could work here, if we could get the ARRL to make some desperately needed changes to make hamming more attractive to kids. Yes, it's that code thing. But it's also our need for promotion, publicity, and even some advertising. Most kids have never even heard of amateur radio. Is it something like CB? Yeah, kid, now get away and stop bothering me.

We know that the vitality of America lies in the education and skills of our workforce. We know that an ability to cope with and use technology has a high priority. So here we are, with the worst and most expensive school system in the world, and with less than 10% of our high school graduates even able to cope with an engineering college. I've done my homework on all this in my work on the RPI Council and the New Hampshire Economic Development Commission, so I'm not exaggerating.

I keep preaching the need to get our schools to institute an eight-year course in electronics, communications, and computers, in grades 5-12. And as part of that we would encourage the kids to get into hamming so they'd be learning because it's fun, not because it's another class in school where all they have to do is pass the final test and move on, forgetting at least 90% of what they learned.

We need five million hams instead of 500,000. How about 50 million? You say that might tend to crowd our bands? Let me remind you that at present we're actually using less than 3% of our assigned spectrum. With ten times as many hams we might expand that to 30% usage. But we might also encourage the development of more spectrum-efficient modes. We know we could get a hundred times as much information exchanged in the same bandwidth with already developed data-compacting techniques.

Bringing in kids could save our bacon. Up until 1963, when the ARRL bombed the hobby and the industry with their infamous and deceptively-named "Incentive Licensing," 80% of all new hams were youngsters. The ARRL directors, led by multi-millionaire Mort Kahn W2KR, put an end to that, as well as the US dominance of the ham manufacturing industry.

Repent! The end is near!

Another Ooops, But Not Mine

The Navy has been busy assuring home owners near their Extra Low Frequency (ELF) stations in Upper Michigan and Cape Cod that these radio waves won't have any effect on them. Thus a new report from the Michigan Technological University may send Navy officials scurrying to

handle damage control.

It seems that these "harmless" radio waves that are used to communicate with submarines are causing up to 50% faster growth of several kinds of trees in the vicinity. Particularly affected were aspen, red maple, and red pine. Now, if radio waves can do that to trees, what may they be doing to the cells of people in the vicinity? We don't know how our cells know where they fit into the body's architecture, but each cell seems to have a blueprint for the whole body and know when to be replaced and by what. We know from the work of Ross Adey K6UI that radio frequency fields can screw up this system, causing serious problems.

I know that if the Navy wanted to put one of the ELF installations anywhere near my home, I'd fight it in every way I could and then, if I lost the battle, I'd move the heck out of there. There are enough outside influences knocking down my immune system without adding one more. And I say that as a veteran submarine electronics technician and thus well aware of the need for submarine communications . . . and of the difficulties involved in getting through to submerged subs.

Whadaya read?

If you count up the total paid circulation of all three ham magazines, and even if you don't figure any overlap of readers at all, less than half of all licensed amateurs are bothering to read any ham magazines!

Now, is this because over half of us have no real interest in the hobby, or is it that perhaps the ham magazines are unappealing? And that might even include *73*, since over 500,000 licensed hams are not reading it.

I suppose that to the essentially brain-dead who are merely logging call letters, handles, and signal reports, who have no interest in any information about other ham activities, are satisfied with their rig, and couldn't care less about any new equipment coming out, there's no need to read a ham rag. Ditto those who are spending their remaining days on one or two local repeaters. The whole idea of getting on packet or making satellite contacts is so far beyond their conception that magazine space devoted to these activities is irritating.

The next time you're on the air, start asking the chaps you contact which of the ham magazines they read. Ask them which they enjoy the most; which they've found helps them learn more about technology; which has inspired them to try some new ham activity. Please keep track and send me a copy of what you've discovered. I want to know what I'm up against. Or whether I should just give up trying to get hams enthused about our hobby and go on a long vacation and DXpedition.

Beyond that I'd appreciate it if you'd take a good critical look at *73* and let me know how it shapes up for you on the above questions. We do have far more reviews of new products than the other ham rags, but maybe you haven't noticed. It's fun to get something new now and then, and our readership surveys always show a top interest in reviews. We tend to steer away from heavy contest coverage, even though I used to enjoy them. *CQ* is so totally devoted to contests that I leave that niche to them.

How does *73* rate in comparison with the others? Going by my mail, it seems that it rates highest with most readers. But then, if I'm going to attract more readers I've got to know where *73* really stands.

The magazine was doing very well when I was forced to sell it to IDG a few years ago. When I sold all of my computer magazines, I had to sell the buildings that went along with them, plus all of my publishing equipment. That left me with no way to produce *73*. Oh, they said that they wouldn't make any changes and that they wanted me to continue my editorials. But as soon as the ink dried on the agreement, I was out. They didn't even tell me about it; I had to find out by reading the local paper. It took me almost a year to build a new publishing business so I could start *Digital Audio*. Meanwhile, *73* just about fell apart under the new management. It lost half its circulation and half its advertising, and was heading for the pits when I finally got it back.

By then I was deeply into the music business, publishing *CD Review, Music Retailing,* and *IMPS Journal.* Plus I had a couple record companies, a recording studio, and a few other ancillary businesses. That kept me from really concentrating on rebuilding *73*'s circulation. Now that I've sold most of my music publications and businesses, I'd like to get *73* back to being the biggest of the ham rags. And that means getting more readers. More readers will attract more advertising, and for every page of ads we can run an extra page of articles for you.

So see what you can do to find out why about 90% of the hams are not reading *73*, and let me know. What do I have to do, start a national ham organization and run 20 pages or so of club news every month? I'd rather get hams doing more things,

and maybe even thinking now and then. It's kinda fun.

What You Can Do!

I've probably been boring you with my constantly urging you to get kids involved with amateur radio. Presumably you agree with me that unless we make some headway with attracting kids, we could easily lose everything. The old basis and purpose for our government-supported hobby have been mostly blown away by changes in technology. Well, we don't want to be in the same position with amateur radio as workers are who have not developed new skills to cope with technological changes. Hey, I've been doing the same job for years and now I've been fired!

So yes, there is something that you can do that will help. As I've mentioned, when I give talks on entrepreneurialism at schools and colleges, I always ask for a show of hands of those who know about amateur radio. I see very few hands. With no organization to get us PR, the result is very few newspaper or magazine articles, and almost nothing on broadcast radio or TV. The ARRL apparently doesn't want to spend any of those millions they've socked away to hire a PR person to help promote the hobby. The directors seem to feel that our bands are already too crowded, so who needs more hams?

One simple way to help kids know more about hamming is to make sure that their school libraries have subscriptions to *Radio Fun* and *73*. For $30 you can endow your local school library with a year's subscription to both publications. And how about your local public library, too? Libraries are underfunded, so they need help with magazine subscriptions. Make out a check to *73* magazine or provide your credit card number and the address of the school libraries you wish to endow with subscriptions. We'll start the subscriptions and send a letter informing the principal of the school of your gift, suggesting it be posted so the students will be aware that the magazines are now available in their library. Even if your subscription only gets one youngster into amateur radio, it'll be a wonderful bargain for you.

Paying The Freight

So here we are, having fun making our ham contacts—around town via our repeaters, around the country, and around the world. We're having a ball with packet, RTTY, slow-scan, ATV, ham satellites, and so on. Of course, unlike some other countries, we don't have to pay anything for the use of our ham bands. I guess we figure that as Americans we have some sort of birthright to them. And we also believe we have the right for our government to pick up the tab for what it costs to keep our fun going. And that they should also act as policeman, judge, and jury when we have any problems.

You know, when I got into hamming, back almost 60 years ago, we were paying our way with services to our country. Our country got a huge payback when WWII came along, and never mind any benefits we'd provided in emergencies. We had about 50,000 licensed hams at that time and our average age was in the high 20s. Eighty percent of the hams joined the armed forces and we contributed very significantly to the war effort. I was there. I joined the Navy and went to their electronics schools to learn about the Navy radio, sonar, and radar equipment. Their schools were superb. Most of my instructors were hams, as were many of my classmates, and we Radio Technicians (RT-3/c) had no problem in learning how every circuit of the Navy receivers, transmitters, sonar, radar, and test equipment worked. Thus we were able to quickly fix anything we might run into.

Of course in the 1930s we hams had to build and service our own rigs. We bought our receivers, but we had to fix them ourselves. Now most of us buy everything and send it back to the factory when it breaks. How many hams do you know who can help you fix your synthesized transceiver if it conks out?

Amateur radio, as you know, has changed. Few hams build anything but kits now. Almost none of us are able to fix a broken rig. Where in the 1930s hams were years ahead of the military in equipment design, today we are hopelessly out of touch with the state of the communications art.

When I went to work for GE during the summer of 1941, testing their BC-191 and BC-375 transmitters, I couldn't believe how seriously outdated the design was. When I checked, I found the design had last been modified in 1935.

While it seems unlikely that we'll ever have to gear up for another major war, we hams would have almost nothing to offer if one occurred. Our value to the military is obviously no longer a valid reason for our government to spend millions of dollars maintaining our hobby. Nor is our vaunted ability to copy the code.

I'm old enough so I can remember when we used to be in the forefront of radio technology. We pioneered FM, NFM, SSB, SSTV, and so on. Well, those laurels withered away years ago. Now I see hams pushing

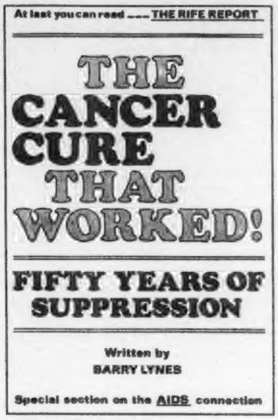
to keep the code test as a barrier to new hams, knowing that the code hasn't been of any real use to the military for almost 50 years. And one look at the technical articles in the ham magazines today would show any engineer that we are years behind today's technology. Is there a term for reverse pioneering?

With Congress looking for every possible area to cut government expenses, what would you say to a congressional committee in support of the FCC's expenses for maintaining our billions of dollars of ham spectrum, the costs of licensing, and monitoring? Would you say, "Look what we did for you 50 years ago"? And if their support staff has done their homework for them, they might point out that ham radio today is little more than a sort of retired white men's federal welfare program.

What do you propose we do about this?

Can RF Cure Cancer?

More of Wayne's baloney? Or could it be true? You're going to want to get a copy of an amazing book on the life of Royal Rife and read about a chap who invented a superpowerful microscope back in the 1920s, one that enabled him to see microbes and viruses smaller than any other microscopes could let people see, yet do it



without killing them.

Electron microscopes provide similar magnifications, but they can only let us view dead material. Rife was able to see filterable microbes and viruses as they lived and multiplied. He discovered while watching them that one particular radio frequency could resonate and blow each type apart. With this tool he was able to build radio generators which were curing cancer and many other illnesses back in the 1930s.

So what happened to this amazing discovery? It was another victim of the American Medical Association's control of the industry, and its power with the FDA. The story is that the head of the AMA demanded part of the action. When Rife refused, the FDA moved in and destroyed Rife's generators and even his microscopes!

You'll want to read about all this in *The Cancer Cure That Worked!* by Barry Lynes. It's available from Marcus Books, Box 327, Queensville, Ontario, Canada L0G 1R0. If there is enough interest, I'll see if we can stock it in Uncle Wayne's Bookshelf. If there isn't enough interest, that'll be proof to me that your curiosity has truly been killed by our school system.

As you read this 168-page paperback, you'll find that Rife discovered that microbes don't cause illness; they're the result of it. Oh well, our so-called health care system is always treating the symptoms and not the causes of illness, so what's new? And now we're seeing a renewed attack on alternative approaches to health by the FDA in cities all around the country. Please save us from our government bureaucrats.

Of course you can wait until some dread illness strikes you or your family and then wonder if your doctor knows what he is doing as he puts you through chemotherapy or bypass surgery. You aren't going to like the answer if you read much about the alternatives. Could tuning your rig to one specific frequency blast out cancer cells? Or can AIDS be cured by putting a small voltage across your ankles?

I hope you read enough to know the sorry recent history of stomach ulcers and the fight of one doctor to get the medical industry to recognize that they're caused by a microbe *(H. pylori)*. The AMA and the FDA fought him viciously for years. Now they sheepishly admit that, by golly, he was right. The New Yorker had a fine article on this, as they have on several other health matters.

If you've read about anyone else pursuing the Rife approach to getting rid of microbes and viruses, please clue me in.

Cover Photos

We need a good cover photo every month; so keep your eyes peeled for interesting ham subjects. Kids, unusual antennas, action, club activities, unbelievable ham shacks. The *73* cover requires a vertical format, with some uncluttered space on the left to list features, so keep your camera turned sidewise. You'll get pretty good shots with 35mm if you use a tripod, but a larger negative is preferred. Your pictures should be very sharp. We pay $100 or so and you get the by-line. Now let's see what you can do.

Number 21 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

SEP 16

GLORIETA, NM The Northern NM ARC will sponsor their annual Hamfest 8:30 AM-3 PM at the Glorieta Conference Center, Patio Building, 16 mi SE of Santa Fe on I-25, exit 299. VE Exams at 10 AM. Talk-in on 146.52. Contact *Helenrose Burke W5IXS, Box 73 HCR, Ojo Sarco NM 87521. Tel. (505) 689-2367*. For hotel/motel room, contact *Glorieta Conference Center, P.O. Box 8, Glorieta NM 87585; Tel. (505 757-6161*.

GRAND RAPIDS, MI The Grand Rapids ARA will hold its ARRL approved "Super Swap 95" at Unity Christian H.S., 3487 Oak St., Hudsonville MI. Setup at 6 AM; doors open at 8 AM. For ticket info and table reservations, contact *Jeff Belknap N8RWS, 454 Harp St. SE, Kentwood MI 49548*, or call *(616) 531-7899*.

PHOENIX, AZ Sixteen local amateur radio clubs of Phoenix will sponsor the 3rd annual Family Amateur Radio Event, 9 AM-2 PM at Rawhide Rodeo Pavilion, 23000 N. Scottsdale Rd. (north of Scottsdale). The Entrance is on Williams Rd. Swap Meet. ATV. Packet. Exhibits. Lots of great non-ham activities. Talk-in on 146.76. For info, contact *Len Winkler KB7LPW, (602) 861-0303*. For advance tickets, spaces, write to *FARE, P.O. Box 9219, Phoenix AZ 85068*. Please enclose SASE.

RANDOLPH, VT The Central Vermont ARC's 7th annual Fall Foliage Hamfest/Computer Fair will be held at the Judd Gym., Vermont Tech. College, 9 AM-3 PM. VE Exams at 12:30. Forums. Flea Market. Talk-in on 147.09/.69 and 146.625/.025. Contact *Barry Driscol N1NPU, RR 1 Box 3165, Barre VT 05641; (802) 479-1408*; or *Tom Girardi WA1YNU, P.O. Box 261, Waterbury VT 05676; (802) 244-7836*.

SANTA ROSA, CA Sonoma County Radio Amateurs annual Flea Market/Auction will be held at Holy Ghost Hall, 7960 Mill Station Rd., Sebastopol CA. For info/pre-reg., sénd SASE to *Rick Reiner, 2120 Slater St., Santa Rosa CA 95404. Tel. (707) 575-4455 (exams)*.

SEP 16-17

PEORIA, IL The Peoria Area ARC will present "Peoria Superfest '95" at Exposition Gardens. VE Exams on Sun. Contact *Ron Morgan KB9NW, Chairman, Peoria Superfest '95, c/o The Peoria Area ARC, Box 3508, Peoria IL 61612-3508*. Or dial the *(309) 685-6698 answering service*.

SEP 17

ADRIAN, MI The Adrian MI AARC Hamfest/Computer Show will be held at Lenawee County Fairground, 8 AM-2 PM. Talk-in on 145.37(-). VE Exams, walk-ins accepted. Contact *Greg KZ8X, 4281 Mohawk Trail, Adrian MI 49221. Tel. (517) 263-1153*.

MT. CLEMENS, MI L'Anse Creuse ARC will hold its 23rd annual Swap & Shop, 8 AM-2 PM, at L'Anse Creuse H.S. in Mt. Clemens. VE Exams at 11 AM. Contact *Don Olszewski WA8IZV at (810) 294-1567: Prodigy ID#SSTG41a*. For info, send SASE to *Mark Castiglione N8REZ, 26279 Fairwood, Chesterfield MI 48051-3031. Tel. (810) 949-2508*. Talk-in on 147.08(+) or 146.52 simplex.

NEWTOWN, CT The Western CT Hamfest will be held at the Edmond Town Hall, RT 6, 9 AM-2 PM. Setup at 7 AM. Exit 10 on I-84. Talk-in on 147.12/.72. Flea Market. New equip. dealers. Computers. Tailgating. Contact *Ken Weith KD1DD, P.O. Box 3441, Danbury CT 06813-3441. Tel. (203) 743-9181*.

PITTSFIELD, MA A Hamfest, sponsored by the Northern Berkshire ARC, will be located at Teconic H.S. on Valentine Rd., 8 AM-2 PM. Setup at 7 AM. Talk-in on 146.91. VE Exams at 9:30 AM. Walk-ins accepted. Flea Market. Contact *Chuck Lowery N2IZ, (413) 447-8377*.

SEP 23

NEWPORT, NH CVFMA "For Sale and Trade Social" will be held at Sugar River SB Community Room, Main St., 35 mi north of Keene NH; RTE 10 and RTE 10 south I-89 exit 13 or RTE 11 west from I-89 exit 12. Setup 12:30 PM. Public 1 PM-4 PM. This event will be held after a test session. Talk-in on 146.760. Contact *Conrad Ekstrom WB1GXM, P.O. Box 1076, Claremont NH 03743. Tel. (603) 543-1389*.

SEP 23-24

VIRGINIA BEACH, VA The Virginia Beach Hamfest and ARRL Virginia State Convention will be held at Virginia Beach Pavilion. Commercial Booths: *Lewis Steingold W4BLO, 1008 Crabbers Cove Ln., Virginia Beach VA 23452; (804) HAM-FEST*. Tickets and Tables: *Manny Steiner K4DOR, 3512 Olympia Ln., Virginia Beach VA 23452; (804) HAM-FEST*.

SEP 24

COTTLEVILLE, MS The St. Peters ARC Swapfest will be held 7 AM-1 PM at St. Charles County Comm. College Campus, 4601 Mid Rivers Mall Dr., Cottleville MS. VE Exams. Talk-in on 145.41 and 444.275 MHz. Contact *Jay Underdown W0OGS, 58 Judy Dr., St. Charles MO 63301. Tel. (314) 723-4200*.

FRAMINGHAM, MA The Framingham ARA will hold its Fall Flea Market and Exams at Framingham H.S., A St. Doors open 9 AM to early bird buyers; 10 AM to all buyers. Setup is 8 AM. Table Reservations: *Lew Nyman K1AZE, (508) 879-7456*. Send check payable to *FARA, P.O. Box 3005, Framingham MA 01701*. To register for Exams, send check for $5.90, payable to *ARRL/VEC*, to *Dick Marshall WA1KUG, 37 Lyman Rd., Framingham MA 01701*. Walk-ins not accepted after 10 AM. Talk-in on 147.15/R.

YONKERS, NY Metro 70cm Network will host a Giant Electronic Flea Market, 9 AM-3 PM at Lincoln H.S., Kneeland Ave. VE Exams. To reg., call *Otto Supliski WB2SLQ, (914) 969-1053*. Talk-in on 440.425 PL 156.7; 223.760 PL 67.0; 146.910 Hz; or 443.350 PL 156.7. Mail paid reservations to *Metro 70CM Network, 53 Hayward St., Yonkers NY 10704*.

SEP 30

ELMIRA, NY The Elmira ARA will present the 20th annual Internat'l Hamfest at the Chemung County Fairgrounds, 6 AM-5 PM. Flea Market. New Equip. Dealer Displays. Advance tickets: *Dave Lewis, RD1 Box 191, Van Etten NY 14889. Tel. (607) 589-4523*.

OCT 1

LIMA, OH The NW Ohio ARC will hold a Hamfest at Allen County Fairgrounds, State RTE 309. Opens at 8 AM. VE Exams, all classes, with complete FCC Form 610 and a check for $5.90, made payable to *ARRL/VEC*. Send to *Jon Solomon W8TY, 1370 Stevick Rd., Lima OH 45807*.

QUEENS, NY The Hall of Science ARC Hamfest will be held 9 AM-3 PM, at the NY Hall of Science, 47-01 111 St. Ham Radio/Computer Flea Market. Tune-up Clinic. ARRL info. For more details, call (nights only), *Arnie Schiffman WB2YXB, (718) 343-0172*; or *Charlie Becker WA2JUJ, (516) 694-3955*. Talk-in on 444.200 WB2ZZO/R and 146.52 simplex.

OCT 7

BELTON, TX "Ham Expo '95" will be sponsored by the Temple ARC, starting at 7 AM at Bell County Expo Center at 1 PM. VE Exams. Transmitter Hunt. Talk-in on 146.82. Contact *Temple ARC, 2014 S. 53rd, Temple TX 76504. Call* Mile WA5EQQ, (817) 773-3590; e-mail: 72437.424@compuserve.com *or* laird@vvm.com.

OCT 8

DURHAM, CT The 1995 Nutmeg Hamfest/Computer Show will be held at the Fairgrounds in Durham CT, 9 AM-3 PM. Setup Sat., Oct. 7th, at 4 PM. VE Exams; contact *Joel Curneal N1JEO, (203) 235-6932. Sponsors: Meriden ARC; Middlesex ARS; and Shoreline ARC. For Hamfest info, call* Bill Wawrzeniak W1KKF, (203) 269-8252 eves. *General info on packet* KA1NRG.CT.USA.NA. *Vendors contact* Dan Murphy KA1SZP, 162 Tri-Mountain Rd., Durham CT 06422; (203) 349-1304 eves.

SPECIAL EVENT STATIONS

SEP 9-10

ASHEVILLE, NC The Western Carolina ARS, and its club station W4MOE, will hold its annual Special Events Operation from Mt. Pisgah and Blue Ridge Parkway, 1600Z Sat.-1600Z Sun. The event commemorates the 100th Anniversary of the opening of the Biltmore Estate by George Vanderbuilt, which included the Mt. Pisgah and Pisgah Nat'l. Forest area. Operations will be on HF, VHF and UHF, with modes including SSB, CW and Packet. For QSL and a special commemorative certificate, send your QSL card and a large manila SASE with two units of postage, to *W4MOE, c/o WCARS, P.O. Box 1488, Asheville NC 28801*. For info, contact *Dan Henderson WA4QQN, Operating Event Coordinator, WCARS, P.O. Box 188, Skyland NC 28776. Tel. (704) 669-4450*.

SEP 11-16

ATLANTIC CITY, NJ Southern Counties ARA will operate K2BR from the Miss America Pageant on Absecon Island (IOTA: NA 111). Freq.: Phone - 25 kHz inside lower General class bandedge; CW - 65 kHz inside lower General class bandedge; Novice 28.100 - 28.500 kHz. QSL with #10 SASE via *SCARA, P.O. Box 121, Linwood NJ 08221*. A certificate commemorating the 25th Anniversary of the Station and the 75th Anniversary of the Miss America Pageant will be sent with the Miss America QSL card. Operations will start at 10 AM EST, Sep. 11th.

SEP 17

NEWTOWN, CT The Candlewood ARA will operate W1QI 1300 UTC-1700 UTC to commemorate its 55th year of affiliation with the ARRL. Operations will be on or near 7.280 and 14.280. For a certificate, send QSL and a 9" x 12" SASE to *CARA, P.O. Box 3441, Danbury CT 06813-3441*.

SEP 23

GILFORD, NH The Nashua Area RC will conduct a demonstration of amateur radio at "New Hampshire Jamboree '95" at the Gunstock ski area. Station WB1FFZ will be on the air from 1200 UTC-2100 UTC. Freq.: Phone - 3.940, 7.090, 14.290, 18.140, 21.360, 28.350, 24.960, 28.350, and 28.990; CW - 3.590, 7.030, 14.070, 18.080, 21.140, 24.910, 28.190; Packet - 145.09. QSL, with an SASE, via *WB1FFZ*.

SEP 23-24

RALEIGH, NC WB4ZTF will operate 1300Z-2400Z, both days, to commemorate the Sons of Confederate Veterans presentation of "Echoes of Dixie," the reenactment of the War Between the States (Battle of Wyse Fork NC). Operation will be on 10 and 20 meters CW around 28.350 and 14.050 MHz. Listen for CQ CSA. For a certificate, send QSL and a 9" x 12" SASE to *Stanley M. Grady WB4ZTF, 2512 Win Rd., Garner NC 27529*.

VIRGINIA BEACH, VA The Virginia DX Century Club will operate KE4ZYX from 1400Z-1800Z both days, to commemorate the 20th Anniversary of the Virginia Beach Hamfest. Operation will take place at the hamfest site, on phone and CW, in the General class subbands of at least 20 and 40 meters. For a certificate, send QSL and a 9" x 12" SASE to *N4AIG, 528 Water Oak Rd., Virginia Beach VA 23452*.

OCT 7

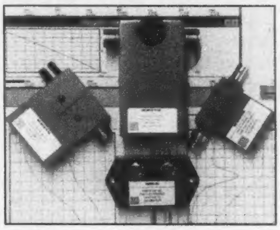
PISCATAWAY, NJ The Piscataway ARC will operate AA2KS 1300Z-2100Z to commemorate Marconi's first wireless transmission from the Twin Lights at the Navesink Highlands in NJ. Operation will be in the lower portion of the General 80, 40, and 20 meter phone bands. For a certificate, send QSL and a SASE to *PARC, P.O. Box 1233, Piscataway NJ 08854*.

NEW PRODUCTS

Number 22 on your Feedback card

Compiled by Victor Lapuszynski

Par Electronics



Par Electronics has introduced filters to help resolve the increasing problem of intermod interference and desense on 2 meters. Previously, expensive and bulky bandpass filters were used, or else smaller ones that needed to be switched out during transmit because of insertion loss. The VHFDN152 solves the problem by notching out the offenders—paging services located in the 152–153 MHz range. Insertion loss is close to zero, VSWR is less than 1.2:1, and the filter allows for reception of the 120–175 MHz spectrum for those radios so equipped. A smaller model (VHFDN152HT) at lower power has male and female BNC connectors to connect directly to an HT. The VHFDN152Q, which measures 2" x 4" x 3.5", is designed for packet and mode B satellite users. This filter permits notching an offending frequency as close as 700 kHz to the desired passband.

Each of the amateur models has a counterpart for VHF scanner enthusiasts. For more information, contact: *Par Electronics, 6869 Bayshore Dr., Lantana, FL 33462; (407) 586-8278, fax: (407) 582-1234.* Or circle Reader Service No. 201.

Fieldpiece

The LT6 is a low-cost DMM that works with all of Fieldpiece's accessories. Service technicians want a multimeter that's inexpensive and has ranges and functions that they can use, without a lot of unneeded functions that just get in the way. For $39.00, this unique meter measures volts (AC/DC), ohms, and amps (AC/DC), indicates continuity by beep, and tests power semiconductors for catastrophic failure. Yet it can further attach accessories such as a 300 A current clamp, a dual-temperature converter, a microamp head, or a relative humidity head. Furthermore, for low ranges (200 mVAC/mVDC), the LT6 can display an accuracy 10 times that of most other DMMs.

Fieldpiece offers products that are small, easy to use, and versatile. For further information, contact: *Fieldpiece Instruments, Inc., 231 E. Imperial Highway, Suite 250, Fullerton, CA 92635; (714) 992-1239, fax: (714) 992-6541.* Or circle Reader Service No. 202.

RF Applications

The P-1500 Digital RF Power/VSWR Indicator is the newest addition to the company's family of digital RF power measurement equipment. The P-1500 features a four-digit numeric and a bargraph-style display. Forward power, VSWR, reflected power, and true power can be displayed. Using a built-in sensor, the P-1500 automatically selects from three ranges (0–120 W, 0–750 W, and 0–1,500 W), so there are no range switches. Frequency coverage is 1.8 to 30 MHz. The P-1500 continuously monitors VSWR, and there are indicators to signal VSWR over 3.0 and less than 1.5 (even when VSWR is not selected on the display). The P-1500 operates on 12 VDC and measures 4" wide by 3.5" high by 4" deep. The P-1500 lists for $219.95. *RF Applications, Inc., 9310 Little Mountain Road, Kirtland Hills, OH 44060.* Or circle Reader Service No. 205.

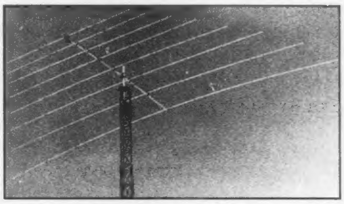
Active Antenna Scrapbook

So what's an "active antenna?" It's one using a preamplifier, generally to make up for a shorter antenna than would work best. But it also helps cut down your noise. Read all about it in a 29-page, self-published booklet by Ken Cornell W2IMB. It has antennas, and circuits for a bunch of easily made preamplifiers. Ken may even get you interested in checking out the very low frequencies using some of his active antennas and regenerative detectors. The book is $10 postpaid from *Ken Cornell, 225 Baltimore Ave., Point Pleasant Beach NJ 08742 (908-899-1664).* Tell him Wayne sent you.

On the other hand, maybe you aren't curious about stuff like this, in which case find a 5- by 10-cm board about a meter long and start hitting yourself on the head until you wake up. Or circle Reader Service No. 204.

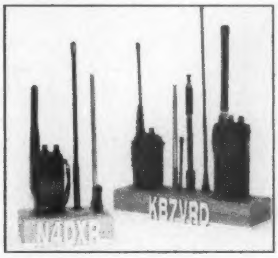
Cushcraft Corporation

Cushcraft has announced the ASL-2010 SkyLog Log Periodic Antenna for hams who would like to have a single antenna covering 13.5 through 32 MHz. Because it uses a single feedline, with included balun, there's no need to switch antennas when changing bands. The antenna is not power limited and can operate easily and continuously at full legal limit. Without any kind of traps, the wind load is reduced significantly (10.1 sq. ft.). Boom is 18'; gain, 6.4 dB; and it has eight elements, the longest of which is 38'. Boom, elements, brackets, and mounting plates are aluminum; U-bolts and worm clamps are stainless steel.



List price is $800. For more information, contact: *Cushcraft Corporation, P.O. Box 4680, Manchester, NH 03108; (603) 627-7877, fax: (603) 627-1764, E-mail: sales@cushcraft.com.* Or circle Reader Service No. 203.

Shack Attack



Here's a great way to keep your HTs from getting knocked around. The Handie Station, from Shack Attack, provides a safe way to store your HTs and keeps the antennas handy. The Handie Station is made from alder wood (a medium-dark wood) and has a drop-in slot that is custom cut to your HT specs, with additional drop-ins to hold antennas. The top edges of the Station and drop-ins are routed, so your HT is easy to put in and take out. The bottom of the HT drop-in slot is lined with rubber to cushion your radio, and rubber grips are fastened on the base to prevent slipping. Each Handie Station is personalized with your callsign mounted on the front in large 2" laser-cut letters made from 1/8"-thick birch. Each unit is sealed with two coats of clear polyurethane gloss for a beautiful natural appearance.

There are two models to choose from, each having a small footprint that is easily accommodated by any ham's shack. The dimensions of the one-radio model, "Single Handie Station," are 6" x 3-1/2" x 2", and it holds four antennas. Those of the two-radio model, "Dual Handie Station," are 11-1/2" x 3-1/2" x 2", and it stores up to six antennas.

The Single Handie Station is available from Shack Attack for $12.95; the Dual Handie Station is $15.95. Shipping and handling is $3.50 for each item ordered. Be sure to include the dimensions or footprint and make/model of your HT. Quantity discounts and club fund-raiser programs are available. Call toll-free (800) 573-7388. E-mail: kb7vrd@aol.com. *Shack Attack, 1394 N 770 W, Dept. 73, Orem, UT 84057-5903.* Or circle Reader Service No. 206.

BARTER 'N' BUY

Number 20 on your Feedback card

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, *73 Magazine*, 70 Rte. 202N, Peterborough NH 03458, and get set for the phone calls.

The deadline for the November 1995 classified ad section is September 11, 1995.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd USA. Send to: **ALLABOUT BOOKS**, Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

SUPERFAST MORSE CODE SUPEREASY Subliminal cassette $12. LEARN MORSE CODE IN 1 HOUR. Amazing supereasy technique $12, both $20. Moneyback guarantee. **Free catalog: SASE** Bahr-T1, 150 Greenfield, Bloomingdale, IL 60108 BNB221

WANTED Western electric amplifiers, tubes, speakers & parts. **Free Quote!** 1-800-251-5454. BNB268

COMMODORE 64 REPAIR. Fast turn around. **SOUTHERN TECHNOLOGIES AMATEUR RADIO,** 10715 SW 190th Street #9, Miami FL 33157. (305)238-3327. BNB295

KENWOOD AUTHORIZED REPAIR. Also ICOM, Yaesu. **GROTON ELECTRONICS,** Box 379, Groton MA 01450. (508)448-3322. BNB310

NOW ON 40 METERS! NEW, KNOB-TUNED w/DIGITAL DISPLAY, SYNTHESIZED qrp transceiver. Complete kit only $199.95. S&H $7.50 (continental US). GUARANTEED TO WORK. For info send SASE: Call/write to order: **S & S ENGINEERING,** 14102 Brown Road, Smithsburg MD 21783; (301)416-0661. BNB334

RCI-2950/2970: New modification manual including Power increase. Clarifier modification. Modulation increase. Operating hints, and more. Parts included. Only $20.00 ppd in U.S. (Missouri residents add $1.15 tax). **SCOTT**, P.O. Box 510408, St., Louis MO 63151-0408. (314)846-0252. Money Orders or C.O.D. BNB340

73 MAGAZINES From first issue (Oct.1960 thru Dec.1987) $175.00. BNB349

Continued on page 82

PROPAGATION

Number 24 on your Feedback card

Dennis S. Kopecky WJ2R

Dennis S. Kopecky WJ2R
P.O. Box 875
Rahway, NJ 07065

Amateur Persistence

The first rule of DXing (and all of amateur radio, too) is: Listen, listen, listen.

The next most important rule is: Be there to practice Rule No. 1!

Okay, so we all admit conditions could be better. But along with filling in for your column's conductor once in a while as he takes a much needed vacation, it also gives me great pleasure to do Rule No. 1 as often as time permits. And as many of you as possible should be out there to do Rule 1, as often as your time permits.

Consider the major contest weekends: Even if conditions are not like what we saw in 1989 through 1991 or 1992, we still see phenomenal scores. But why? Because the bands are heavily populated with a large part of the amateur community out there, participating for whatever reason they wish, the chances of making that needed contact are bettered. My point is that even when conditions are not supposed to be good, it may still be possible to work the DX that you might have missed if you hadn't tried. If enough stations worldwide would take this "let's-try-and-see" attitude, conditions might not really be so bad after all. I know that even with these "poor" and "fair" levels in W1XU's forecasts, in the weeks preceding this column I was adding a country or two a week, beyond DXCC!

September promises to be a month of contrasts in the propagation scene. We can expect some fireworks in the early and middle parts of the month, but too much atmospheric noise will make DXing a hobby for the patient and persevering. It may be possible to work some DX in the higher bands during the last third of the month. As always, look for conditions to match what is predicted, one or two days before or after the specified date, and also don't forget your 18-minutes-after schedule with WWV, to get an indication of the current conditions.

10 and 12 Meters

Not expected to be very good, but still should be monitored for trans-equatorial/tropical paths during the daylight hours.

15 and 17 Meters

Similar in overall outlook as 10 and 12 meters, but with better chances to work DX because of the outright popularity of these bands throughout our worldwide community.

20 Meters

This is your workhorse band for worldwide DX during the daylight hours this month, with occasional openings beyond local time sunset, moving from east to west, and long skip north and south.

40 Meters

DX on this band should be available from just before sunset until just after sunrise, which also means broadcast station interference in the phone portion of the band. Concentrate on the days marked fair or even poor, as conditions on the higher bands (which should still be checked) may make them unusable.

80 and 160 Meters

Expect some fairly good DX and short-skip openings during the hours of darkness, which, as we enter the change of seasons, will be lengthening the time we will be able to pursue our pastime!

VLF (160–190 kcs)

Anyone with interesting happenings in this portion of the spectrum are invited to contact either Jim or me. We'd like to receive data regarding conditions over a period of time—that is, fair, improving, to very good over a period of days, and vice versa—with signal levels, distances worked, time of day, and so forth (the usual stuff! TNX).

SEPTEMBER 1995						
SUN	MON	TUE	WED	THU	FRI	SAT
					1 F	2 P
3 P	4 F	5 G	6 G	7 F	8 F	9 G-F
10 F	11 F-G	12 F	13 F	14 P	15 P	16 P
17 F	18 G	19 G	20 G	21 VG	22 G	23 VG
24 G	25 F	26 G	27 G	28 F	29 F-G	30 G

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40	40		20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

1Check next higher band
*Bp-Meters possible on good days only

September should bring some very disturbed conditions blended with excellent fall propagation on the HF bands. Expect an unsettled geomagnetic field on the 1st and 2nd, and an active field from the 5th or 6th through the 10th. We may see the return of significant sunspot activity—and possibly a flare! Earthquakes and volcanic eruptions possible around the 2nd and 11th.

G = Good, F = Fair, P = Poor, * = Disturbed magnetic field coupled with some unusual geophysical conditions (50–75% probability).

HR2510, RCI2950, CONNEX 3300, COBRA 148, GALAXY SATURN, plus many more kits to increase your modulation, $19.95. **(800)536-0109.** BNB350

2m INTERMODFILTER direct from Inventer. Original only in Die-cast alu box. 3-stage HELICAL filter. Auto R/T switching. $US 79 Mail shipping paid WW,V,MC,AMEX. **M.A.S. ENTERPRISES** 104 King S. St. JACOBS on N0B 2N0 519-664-2896 Fax 519-664-3082 BNB360

WANTED: Squires-Sanders SS1BS, SS1RS, SS1R, SS1V **WEBER**, 4845 West 107 Street, OAK Lawn Illinois,60453-5252 BNB381

IT'S BACK! The return of the HW-8 Handbook! Second printing. Modifications for the Heath QRP rigs. First class mail $11. DX add $4 for air mail shipping. **Mike Bryce, WB8VGE,** 2225 Mayflower NW, Massillon OH 44647. BNB404

ASTRON power supply, brand-new w/warranty, RS20M $95, RS35M $139, RS50M $199. Call for other models. **818-286-0118.** BNB411

CALL SIGN BADGES plaques & trophies, general engraving S.A.S.E. for price list **PETE'S ENGRAVING** 722 S. 138 E. Ave. Tulsa OK 74108,(800)899-9674 Ext.2835 Fax/voice BNB417

MAHLON LOOMIS, INVENTOR OF RADIO; by Thomas Appleby, (Copyright 1967). Second printing available from JOHAN K.V. SVANHOLM, N3RF, SVANHOLM RESEARCH LABORATORIES, P.O.Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H BNB420

Butternut Antennas New in box. 1 hf2v $140 , 1 hf5b $200. Also 1 prop-pitch rotator $200 **(210)435-6190** BNB435

QRZ! Callsign Database on CD-ROM $21.95!!! Over 750,000 callsigns, thousands of ham programs, mods, etc. Runs on OS/2, WINDOWS, DOS, and UNIX.**To order call** 1-800-260-8860, 1-909-517-1100, or fax (24 hrs) 1-909-517-1105. **Rom-Dezvous Multimedia,** 3811 Schaefer Ave. Suite 1, Chino, CA. 91710. S&H $5.95. Visa, MC, Disc, Amex, personal checks. BNB440

HAMS—NEED COMPUTER RIBBONS? Lowest prices. Color or black. State your needs. Free info. **HARCLY(I),** P.O.Box830A, Coquille, OR 97423 BNB457

Secret Powers? Prove to yourself the impossible is real! Amazing and Wonderful Mind Machines You Can Build. Order Today! $17 post paid. **Hither & Yon** P.O.Box 215 Chula Vista, CA. 91912 BNB465

CANADIAN QSL's $1.00 Brings samples. VE7FI 18610-62nd Avenue, Surrey, B.C., V3S 7P1 BNB475

WHY RISK FAILURES With Aerial Supports? Dacron rope, high UV resistant, nonstretch Military Type black DOUBLE (unlike our competitors' single) braided. 1-800-328-4773. BNB557

SATELLITE EQUIPMENT Best $$$ USA. (800) 851-6534. BNB640

For Sale Computer 286AT, 60MB,3.1 MS-DOS. Printer, Software, Modem **(212-942-6963).** BNB695

Surplus electronic test equipment for sale at deep discounts. Write, phone, or fax to request the current list. **Jim Stevenson,** 3401 Sunny Slope Rd, Bridgewater, NJ 08807 Phone: (908)722-6157 Fax: (908)722-6391 BNB705

ELECTRON TUBES: All types and sizes. Transmitting, receiving, microwave . . . Large inventory = same day shipping. **DAILY ELECTRONICS,** 10914 NE 39th ST. Suite B-6, Vancouver, WA 98682. (800)346-6667 or (360)896-8856. BNB719

Ham & Two-Way Radio Repair Prompt service, competitive prices,**Centurion Communications,**892 N. Delsea Dr., Vineland NJ 08360 (609)794-8000 Fax (609)794-8989 BNB750

HAM RADIO REPAIR—Prompt service. **ROBERT HALL ELECTRONICS,** 1660 McKee Rd., Suite A, San Jose CA 95116. (408)729-8200. BNB751

WANTED: HAM EQUIPMENT AND RELATED ITEMS. Donate your excess gear, new-old-in-any-condition to the Radio Club of Junior High School 22, the nation's only full-time, nonprofit organization working to get ham radio into schools around the country as a teaching tool using our EDUCOM—Education Thru Communication—program. Send your radio to school. Your donated material will be picked up ANYWHERE or shipping arranged, and this means a tax deduction to the full extent of the law for you as we are an IRS 501(c)(3) charity in our 15th year of service. It is always easier to donate and usually more financially rewarding, BUT MOST IMPORTANT your gift will mean a whole new world of educational opportunity for children nationwide. Radios you can write off, kids you can't. Make 1995 the year to help a child and yourself. Write, phone or FAX the WB2JKJ "22 Crew" today: The RC of JHS 22, P.O. Box 1052, New York NY 10002. 24 hours call (516)674-4072 or FAX (516)674-9600. Join us on the **WB2JKJ CLASSROOM NET,** 7.238 MHz 1200-1330 UTC daily and 21.395 MHz from 1400 to 2000 UTC. Meet us at Beachfest 95 on November 11 in Myrtle Beach SC sponsored by the Grand Strand ARC. BNB762

SERIOUS ABOUT SOLAR POWER? The PVSP starter kit comes with a 32 watt Solarex VLX panel and a ten amp Sunlogic charge controller. Special introductory price $275 plus $7 shipping. **SUNLIGHT ENERGY SYSTEMS**, 2225 Mayflower NW, Massillon OH 44647. BNB774

Amateur Radio T-Shirts & Sweat Shirts. Electonics Books. **Send for catolog** Paul Washa 4916 Three Points Blvd. Mound, MN. 55364-1245 BNB805

R-390A SALES & SERVICE. Info SASE: **MILTRONIX**, P.O. Box 80041, Toledo OH 43608. BNB813a

R-390 Power Input Cables $25 Shipped. (419)255-6220 BNB813b

Morse Code Computer Interfaces $49.95, CW Filters $39.95. Free IBM Shareware and Ham Catolog.**Dynamic Eletronics,** Box 896, Hartselle, AL 35640, (205)773-2758 Fax 773-7295 BNB815

FCC COMMERCIAL LICENSE PREPARATION RADIOTELEPHONE-RADIOTELEGRAPH GMDSS. Latest home study fast easy audio video. Q & A pool disks. FREE details **WPT PUBLICATIONS** (800)800-7588. BNB840

Sencore Stereo Generator Sencore CB Analyzer Photofacts for car radios, tapedecks and CB radios. **Call John** (516)321-4402 BNB845

Hi, my name is Steve Tylisz, N9ODW, I'm 18 and will be attending Purdue, majoring in Electrical Engineering in the fall. I have been an amateur operator for the past four years and I have come up with a few nifty ideas for the hamshack that you can put together very easily and inexpensively. I am trying to sell sets of my ideas in the form of complete plans including pictures and diagrams in the hope to raise some money for college. These plans include: a side arm for your tower, 3/4" hardline connectors, 12 volt power strip, and a repeater interface that allows you to hook two radios together to make a repeater. The price for these is $4.00 for all four. Please send orders to **Steve Tylisz,** 117 Stimpson Ct.,Michigan City, IN 46360 **Thanks and 73's!** BNB850

ELECTRONICS GRAB BAG! 500 pieces of new components: inductors, capacitors, diodes, resistors. $5.00 postpaid. **ALLTRONICS,** 2300 Zanker Rd., San Jose CA 95131. BNB855

WANTED: BUY AND SELL All types of Electron Tubes. Call (612)429-9397, Fax (612)429-0292. **C & N ELECTRONICS,** Harold Bramstedt, 6104 Egg Lake Road, Hugo MN 55038. BNB915

COMMODORE 64 HAM PROGRAMS-8 disk sides over 200 Ham programs $16.95. 32¢ cent stamp gets unusual software catalog of Utilities, Game and British Disks. **HOMESPUN SOFTWARE,** Box 1064-BB, Estero, FL. 33928 BNB917

Capacitor Close-out Retiring HamFest Scene. Must Sell thousands of brand new capacitors. Electrolytic, Disc, Tantalum. All must go! Free Listing. **Send SASE to:** James Grogan, Box 20809, Raleigh NC 27619. BNB945

RF TRANSISTORS, Japanese transistors and tubes need dealers, repair shops, kit makers, etc. for 2SC1969, 2SC2312, MB8719, MRF455, MRF454, 2SC2879 and more. **WESTGATE** (800)213-4563. BNB950

FREE HAM GOSPEL TRACTS. SASE. **N3FTT**, 5133 Gramercy, Clifton Heights PA 19018. BNB960

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. **Phone**(616)925-5899, 8-4 ET. BNB964

PRINTED CIRCUIT BOARDS for projects in *73, Ham Radio, QST,* ARRL Handbook. List SASE. **FAR CIRCUITS,** 18N640 Field Ct., Dundee IL 60118. BNB966

AZDEN SERVICE by former factory technician. **SOUTHERN TECHNOLOGIES AMATEUR RADIO INC.,** 10715 SW 190 St. #9, Miami FL 33157. (305) 238-3327. BNB979

ROTOR PARTS ROTOR SERVICE, ROTOR accessories: Brak-D-Lays, Quik-Connects, Pre-Set mods. NEW models for sale. Free catalog. **C.A.T.S.,** 7368 State Road 105, Pemberville OH 43450. BNB996

SECRET CB BOOKS 1-29 $10 ea., SAMS books $15 ea. Tune up masters books 1-6 $20 ea., Uniden export service manual $10, RCI 2950/2970 service manual $10. Call for free catalog of other goodies. **1-800-536-0109.** BNB999

Wanted for Museum: Apple-1 and other pre-1980 microcomputers. Also early microcomputer journals, newsletters and advertising literature. **KK4WW,** 703-231-6478/763-2321. BNB1001

CODE 5 News and Petition information. SASE to **KB7PNQ,** 503 Dubois Atreet, Cheney, WA 99004. BNB1012

AMATEUR RADIO REPAIR, most makes and models, discount labor rates until June 1995. **WESTERN AMATEUR RADIO REPAIR CO.,** John Rupe, Box 697, North Cove, WA 98547; (360) 267-4011. Thanks, AB7DR. BNB1015

Uncle Wayne's Bookshelf

REFERENCE

RS-1 The Amateur Radio Mail Order Catalog and Resource Directory, 4th Edition is the most comprehensive source book for electronic parts, software, and equipment targeted at the radio amateur or serious electronic hobbyist anywhere! Plus a wealth of "value-added" reference material all in 262 pages. 4th Edition clearance at only **$8.95**. (was $16.00)

TAB2701 **Transmitter Hunting** *by Joseph Moell and Thomas Curlee* Radio direction finding simplified. **$19.95**

UE202 **RTTY Today** *by Dave Ingram* Modern guide to amateur radioteletype. **$8.95**

TP002 **The World Ham Net Directory** *by Mike Witkowski* New—2nd edition. Introduces the special interest ham radio networks and shows you when and where you can tune them in. **$9.50**

WGP87158 **1995 North American Callbook** The 1995 North American Callbook lists the calls, names, and address information for 500,000+ licensed radio amateurs in all countries of North America. **$35.00**

MMH24 **Radio Handbook, 23rd Ed.** *by William I. Orr W6SAI* 840 pages of everything you wanted to know about radio communication. **$39.95**

WGP1234 **1995 International Callbook** The new 1995 International Callbook lists 500,000+ licensed radio amateurs in the countries outside North America. It covers South America, Europe, Africa, Asia, and the Pacific area (exclusive of Hawaii and the U.S. possessions). **$35.00**

AR4092 **Your RTTY/AMTOR Companion** invites you to explore the world of HF digital communications. If you've never operated RTTY or AMTOR before, this book is written expecially for you! You won't find complicated technical jargon here. Just information you can use right away. You'll discover how to . . . Assemble your own RTTY/AMTOR station . . . Use RTTY and AMTOR to talk to amateurs throughout the world . . . Compete in RTTY/AMTOR contests . . . Hunt for digital DX. **$8.00**

AR3754 **Radio Frequency Interference—How to find it and fix it.** Interference problems are challenging, but curable. With the techniques in this book, you can help restore electronic peace in your neighborhood. **$15.00**

DOV41 **Basic Electronics** *Prepared by the Bureau of Naval Personnel* Covers the important aspects of applied electronics and electronics communications. **$12.95**

DOV76 **Second Level Basic Electronics** *Prepared by the Bureau of Naval Personnel* Sequel to Basic Electronics, thorough treatment of the more advanced levels of applied electronics. **$9.95**

20N096 **How To Read Schematics (4th Ed.)** *by Donald E. Herrington* Written for the beginner in electronics, but it also contains information valuable to the hobbyist and engineering technician. **$19.95**

WLSWOCP **Radio Operator's World Atlas** *by Walt Stinson, W0CP* This is a compact (5x7), detailed, and comprehensive world atlas designed to be a constant desk top companion for radio operators. **$17.95**

TAB37109 **Secrets of RF Circuit Design** *by Joseph J. Carr* Written in clear non-technical language, covers everything from antennas to transistors. **$21.95**

TAB11065-1 **Mastering Radio Frequency Circuits** by Joe Carr, 411 p. If you're interested in learning about radio components and circuits, this book is great! Plus there are a ton of simple circuits you can build. It explains how circuits work, about test equipment, receivers, the works. This will take a lot of the mystery out of how radios work . . . the easy way. This will be one of your better $20 ham investments. **$20.00**

DP919 **73 Magazine Index 1960-1990** A complete index to every article published in *73 Magazine* through 1990. IBM software **$20.00**

NEW BOOKS

AR4920 **Introduction to Radio Frequency Design** In this practical book, the author emphasizes use of models and their application to both linear and nonlinear circuits, reviews traditional material stressing the viewpoints taken by the RF designer and illustrates subject material by numerical examples. Includes 3 1/2 inch disk for IBM PC or compatibles. **$30.00**

R&D57450 **Raptures of the Deep** *by Fred Jueneman* What we understand in science today, and the challenges facing scientists in just about every field. An incredible job of research on how and why scientists believe what they do about our world and how it works. **$29.95**

GEI3579 **Final Quantum Revelations** Dr. Kiril Chukanov uses not only science but revelation to answer difficult and profound questions about physical reality and cosmic destiny. **$34.95**

TEC7787 **Exploring the Physics of the Unknown Universe** *by Milo Wolff* Packed with intriguing discussions like, What is the origin of the laws of physics? and What is the nature of space? A simple and readable book on how mathematics describes the physical universe and what paradoxes and enigmas remain for an enterprising mind to solve, with speculations on the nature of subatomic particles as standing interference patterns of spherical waves. **$39.00**

SHORTWAVE

NBPAW94P **1995 Passport to World Band Radio** *by International Broadcasting Services, Ltd* You'll get the latest station and time grids. **$19.95**

07R25 **The RTTY Listener** *by Fred Osterman* New and expanded. This specialized book compiles issues 1 through 25 of the *RTTY Listener Newsletter*. Contains up-to-date, hard-to-find information on advanced RTTY and FAX monitoring techniques and frequencies. **$19.95**

09S42 **The Scanner Listener's Handbook** *by Edward Soomre N2BFF* Get the most out of your scanner radio. **$14.95**

CRBSM1 **Scanner Modification Handbook, Vol. 1** *by Bill Creek* provides straightforward step-by-step instructions for expanding the operating capabilities of VHF scanners. **$17.95**

CRBSM2 **Scanner Modification Handbook Vol. 2** *by Bill Creek* Here it is—a companion to Vol. I. In fact, Vol. 2 has a section that provides improved approaches and updated techniques for the mods in Vol. 1. There's 18 new exciting modifications for popular scanners. **$17.95**

TAB 339643 **Tuning In To RF Scanning** From Police to Satellite Bands. Bob Kay. 150p 1994, Tab Books. This is a wonderful book for the VHF-UHF scanner listener. It explains about the various radio bands, antennas, the laws, and lists frequencies for every imaginable service . . . including the Secret Service, FBI, military, IRS, prisons, Fish & Wildlife, McDonald's order windows, nuclear search teams, railroads, Russian satellites, Treasury Dept., wireless microphones for concerts, and so on. **$14.95.**

07A66 **Aeronautical Communications Handbook** *by Robert E. Evans* Exhaustive, scholarly treatment of shortwave aeronautical listening. **$19.95**

AR4025 Beyond Line of Sight. Shows how hams pushed forward the discovery of the propagation modes that make VHF DX possible: tropo, sporadic-E, aurora and auroral-E, meteor scatter, F-Layer propagation, transequatorial propagation and earth-moon-earth. **$12.00**

TAB 447748 **The Shortwave Listener's Q&A Book**—Everything you need to know to enjoy Shortwave Listening. Choosing receivers, accessories, antennas, frequencies, and getting QSLs. SWL is an exciting hobby . . . that's what got me interested in hamming . . . Wayne. **$12.95**

WAYNE'S PICKS

WG2 **The Million Dollar Video** Explains how just about any company can increase sales by over a million dollars through the sneaky (aka intelligent) use of promotion. Explains in detail how you can get tons of free advertising. Uncle Wayne shows you how to beat the system. **$39.95**

"SEEK YOU" by The Ham Band—The titles include "Always on the air", "On the Monday Evening Grayline", "Radio Widow", "The Trip to Dayton", "The Contest" and seven more. Ham radio CD includes experiences that radio hams go through. This is an extremely entertaining CD and will strike a chord with any radio ham, SWL or XYL—an ideal present! **SYCD $15 SYTAPE $10.**

IB8657 **Dumbing Us Down: The Hidden Curriculum Of Compulsory Schooling.** *by John Gatto* If you enjoyed "Declare War", you'll enjoy this also. A Wayne Green recommended reading. **$9.95.**

WG1H **LEARN THE CODE** There are two ways to learn the code, (1) the easy way, (2) everyone else's way. Your choice. There are two speeds of code you need to know — one (5 wpm) you can learn in less than an hour, the other (20 wpm) takes longer, but nowhere near as long as you probably think. Sure, you can also learn it at 13 wpm, if you want, but that just wastes your time.

Learning to copy code is just like learning to type or play the piano, if you have to stop and think, you can't do it. It has to be made automatic, so if you go the usual code training route of starting slow and speeding up you are screwing up. That brings you to that dreaded plateau at about 10 wpm, where you've reached the brain's clock speed. Then you have to start all over from scratch and do it the way you should have in the first place. With Uncle Wayne's tape you start right out at 20 wpm and train your hand to write what your ears hear.

Uncle Wayne gives you a choice on the 5 wpm code test. You can either buy the El Zippo one hour method of passing the test, which is enormously over-priced at $5 (order 73-EZ), or you can buy two tapes . . . one, The Genesis, takes about an hour to teach you the code characters ($5.95 — 73T05) and the other, The Stickler ($5.95 — 73T06) gives you an hour of fiendishly difficult practice at 6 wpm. Then there's the 13 wpm Back Breaker ($5.95 — 73T13), in case you for some masochistic reason want to bother learning the code at 13 per. And the ever popular Courageous 20 wpm tape ($5.95 — 73T20). If you find you've become a code fanatic, there's the 25 wpm Mind Boggler ($5.95 — 73T25) which will serve you right.

Until wiser herds . . . er, heads . . . are able to dump the code requirement from the ham exams, the El Zippo and Courageous are the least frustrating route to ham nirvana. And by the way, anyone can learn the code if they go about it Uncle Wayne's way.

SOFTWARE

GGTE Morse Tutor From beginner to Extra Class. Code from 1 to over 100 words per minute. Standard or Farnsworth mode. Create your own drills. Exams conform to FCC requirements. 5 1/4" floppy for IBM PC, XT, AT, PS/2 or compatibles.

GG52/5 Morse Tutor 5.25" Disk	**$19.50**
GG31/2 Morse Tutor 3.5" Disk	**$19.50**
GGADV5 Gold Edition 5.25" Disk	**$29.95**
GGADV3 Gold Edition 3.5" Disk	**$29.95**

W5GWHO **Ham Operator Education Package Software**, Novice—Extra for PC's, contains both 3 1/2" and 5 1/4" disks. **$39.95**

W5GWNSW **No-Code Ham Radio Software Package for PC's,** contains both 3 1/2" and 5 1/4" disks. **$29.95**

Lanze Code Programs—(Available on 5 1/4" * disk.) Inexpensive complete study guide code programs for both the C64/128 Commodores and the IBM compatibles. Programs include updated FCC questions, formulas, schematic symbols, diagrams, and simulated (VE) sample test.

	IBM Part#	Commodore Part#	Price
Novice	LZIBM01	LZCOM01	**$14.95**
Tech	LZIBM02	N/A	**$14.95**
General	LZIBM03		**$14.95**
Advance	LZIBM04	N/A	**$19.95**
Extra	LZIBM05	LZCOM05	**$19.95**

* Add $2.00 for 3 1/2" Disk

VIS Study Cards Compact, up-to-date Flash Cards with Key Words, Underlined, Quiz on back. Formulas worked out. Schematics at your fingertips. Used SUCCESSFULLY by ages 6 to 81!

NOVICE	VIS01	**$11.95**
TECH	VIS02	**10.95**
GENERAL	VIS03	**9.95**
ADVANCED	VIS04	**15.95**
EXTRA	VIS05	**14.45**

LAST CHANCE ITEMS

ONLY A FEW LEFT

SAM22488 **IC User's Casebook** A 'must' for any hobbist's workshop, covers ideal operation amplifiers, inverting and noninverting followers, linear amplifiers, active filters, digital circuts and waveform generators and timers. **$12.95**

SAM48441 **178 IC Designs & Applications** A comprehensive collection of linear developments for electronic design and basic applications. **$12.95**

ARRL BOOKS

AR1995 **ARRL 1995 Handbook (71st Ed.)** Features: added DSP, improved treatment of Pi and Pi-L, all new all-digital-logic, plus lots more. **$30.00**

AR1086-4 **ARRL Operating Manual (4th Ed.)** Information on how to make the best use of your station, including: interfacing home computers, OSCAR, VHF-UHF. **$18.00**

AR3657 **QRP Notebook** *by Dave DeMaw W1FB* Presents construction projects for the QRP operator. **$10.00**

AR3207 **W1FB's Design Notebook** *by Dave DeMaw W1FB* Filled with simple practical projects that can be built using readily available components and common hand tools. **$10.00**

AR0402 **Solid State Design** Good, basic information, circuit designs and applications; descriptions of receivers, transmitters, power supplies, and test equipment. **$15.00**

AR4173 **Now You're Talking! All You Need To Get Your First Ham Radio License (2nd Edition)** A complete study guide for the Technician and Novice written exam. Practical information every beginner needs is written clearly and simply and in small doses. **$19.00**

AR4971 **ARRL Repeater Directory 1995-1996** 19,000+ listings with digipeaters, bandplans, CTCSS (PL(TM)) tone chart, frequency coordinators, ARRL special service clubs, and beacon listings from 14 MHz to 24 GHz. **$7.00**

AR3398 **The DXCC Companion** *by Jim Kearman KR1S* Spells out in simple, straightforward terms what you need to be a successful DXer. **$8.00**

AR1250 **Log Book**—Spiral **$3.50**

AR3177 **The ARRL Spread Spectrum Source Book.** From a deceptively simple beginning, a group of experimenters set out to develop first theoretical and later practical systems for spread spectrum communications. This book consists of articles, papers and government reports that document the process whereby amateur spread spectrum progressed from the drawing board to the airwaves. **$20.00**

AR2960 **Transmission Line Transformers (2nd Ed.)** *by Dr. Jerry Sevick W2FMI* Practical designs and specific information on construction techniques and sources of material. **$20.00**

AR3851 **Hints and Kinks** Ideas for setting up your gear for comfortable, efficient operation. **$10.00**

ARRL License Manuals Complete FCC question pools with answers.

AR4181	**Technician Class**	$ 6.00
AR4688	**General Class**	$12.00
AR3274	**Advanced Class**	$ 8.00
AR3282	**Extra Class**	$ 8.00

AR3185 **The Satellite Experimenter's Handbook, (2nd Ed.)** *by Martin Davidoff K2UBC* Expanded and revised. Focusing on satellites built by and for the international radio amateur community. **$20.00**

AR2030 **Your Gateway to Packet Radio (2nd Ed.)** Tells everything you need to know about this popular new mode. **$12.00**

AR4645 **Satellite Anthology** The latest information on OSCARs 9 through 13 as well as the RS satellites, the use of digital modes, tracking antennas, RUDAK, microcomputer, and more! **$10.00**

AR4483 **Weather Satellite Handbook (4th Ed.)** *by Dr. Ralph Taggart WA8DQT* Expanded and revised to reflect today's weather-fax satellite technology. **$20.00**

AR4653 **Companion Software for Weather Satellite Handbook** 5 1/4" MS-DOS Floppy. **$10.00**

AR2083 **Complete DX'er (2nd Ed.)** *by Bob Locker W9KI* Learn how to hunt DX and obtain hard-to-get QSL cards. **$12.00**

AR3762 **Your QRP Operating Companion** No special rigs or expensive equipment to enjoy the excitement and challenge of low-power operating. **$6.00**

AR3169 **QRP Classics** Compilation of ARRL publications on building receivers, transmitters, transceivers, accessories. **$12.00**

AR4270 **FCC Rule Book** A must for every active radio amateur. **$9.00**

AR0356 **Morse Code: The Essential Language** *by L. Peter Carron, Jr. W3DKV* Expanded and revised in its 2nd edition. How to handle distress calls heard not only on the hambands but on maritime and aircraft frequencies. **$6.00**

AR3983 **Understanding Basic Electronics** An ARRL book. 314 big pages. This explains everything very simply: the math, DC, AC, transistors, even tubes (wow!). Dirt cheap at $17. Isn't it about time you understood the fundamentals? **$17.00**

WAYNE WRITES

WG1 **We The People *Declare War* On Our Lousy Government**—360p soft cover. This is Wayne's report explaining what the major problems are facing both New Hampshire and the country, and proposing simple, inexpensive solutions: a simple way to have government departments happily cut their expenses by 50% within three years; how to cut the cost of incarcerating prisoners by over 90%; how to end welfare; how to reduce the deficit; how to cut medical costs and improve health care; how to cut school costs and improve schools. An absolute steal at **$13.**

WG4 **20/20 Foresight**—Twenty 16p updates on the **Declare War** book—320p. Further proposals for solving critical American problems, such as a new approach to financing small businesses, how to finance Russia and other countries and make a profit doing it, the real dope on bioelectromagnetics, a new kind of polytechnical university, a new electronics technology, why Africa is in such a mess, why Perot bombed, how to have tuition-free universities, a plan for making Congress turn honest, etc. Plenty more. Ridiculously priced at **$10.**

WG5 **Submarine Life in WWII**—60p. Wayne's story of his adventures on the USS Drum SS-228 on five war patrols in the Pacific in 1943-45. What's it really like on a submarine when you're being depth charged? And what's the day-to-day life on a submarine like? Did you see the movie Das Boot? Exciting stuff and only **$7.50.**

WG6 **Uncle Wayne's Caribbean Adventures**—96p. Wayne's adventures scuba diving all around the Caribbean, visiting ham operators, and sightseeing. If you're interested in how to travel economically, you'll get some great ideas from this. He starts out with his "Diving, the Wimp Sport." You'll love the visits to 11 islands in 21 days trip. A measily **$7.50.**

WG7 **Uncle Wayne's Travels**—52p. Wayne travels to Russia, London, Aspen, St. Pierre, Munich, Vienna, Krakow, and Prague without it costing nearly as much as you might think. Cheap for you too, at **$5.00.**

WG9 **Wayne Talks: 'Dayton' 1995**-90 minute tape-What he would have said if he'd been asked to speak. **$5.00**

ANTENNAS

AR4114 **Low Profile Amateur Radio** For the Ham who lives where antennas are frowned upon. From hiding your antenna to operating with low power. This books tells you how to get on the air using these tehniques, and others,without calling attention to yourself. **$8.00**

UE220 **The Easy Wire Antenna Handbook** *by Dave Ingram K4TWJ.* All of the needed dimensions for a full range of easy to build and erect "sky wires." **$9.95**

WGP87034 **All About Cubical Quad Antennas** *by William Orr and Stuart Cowan* "The Classic" on Quad design, theory, construction, operation. New feed and matching systems. New data. **$11.95**

TAB 3270P **Practical Antenna Handbook**—Second Edition, 1994, Joseph Carr; Tab Books. This 560-page book is a real treasure. Sarts with the fundamentals of antenna and feedline theory, explains about propagation of all kinds, and then provides a ton of easy antenna construction projects. Covers antennas and feeders for all bands. The explanations are simple and well illustrated, with some math, where it's unavoidable, but it won't bog you down. It even has the ZL-Special antenna, which I've used on 20m with some spectacular DXing success. A low angle of radiation and made it so I could always work the rare stuff first . . . Wayne. **$26.95.**

AR4734 **ARRL Antenna Book** The new 16th Edition represents the best and most highly regarded information on antenna fundamentals, transmission lines, design, and construction of wire antennas. **$30.00**

AR0194 **Antenna Compendium Vol. 1** Materials on verticals, quads, loops, yagis, reduced size antennas, baluns, Smith Charts, antenna polarization. **$10.00**

AR2545 **Antenna Compendium Vol. 2** Covers verticals, yagis, quads, multiband and broadband systems, antenna selection. **$12.00**

AR2626 **Companion Software for Antenna Compendium Vol. 2** 5 1/4" MS-DOS floppy. **$10.00**

AR4017 **Antenna Compendium Vol. 3** More verticals, yagis, quads, plus loops, arrays, mobile, direction finding, controlled currents, computerized, installation, overloads, plus 40 new articles for beginner's to advanced. **$14.00**

AR4661 **Antennas and Techniques for Low-Band DXing** can be your ticket to low-band success. Drawing on the experiences of successful DXers and the author's own considerable experience, John Devoldere, ON4UN, shares the tips and techniques that can make the difference between a station that takes part in a contest and one that wins it! **$20.00**

AR3819 **Physical Design of Yagi Antennas** *by David B. Leeson W6QHS* provides the tools here to design and build robust Yagi antennas, using sound mechanical engineering principles. You need no longer fear the consequences of wind or ice storms on your antennas. With this information, you can build or "beef up" existing Yagis. **$20.00**

AR2618 **W1FB's Antenna Notebook** *by Dave DeMaw W1FB* Get the best performance out of unobtrusive wire antennas and verticals. Build tuners and SWR bridges. **$10.00**

WGP87107 **All About Vertical Antennas***by William Orr* Comprehensive coverage of amateur communications. **$11.95**

WGP87042 **Beam Antenna Handbook** *by William Orr and Stuart Cowan* Everything you need to know about beam design, construction, and operation. **$11.95**

WGP87077 **Simple, Low-Cost Wire Antennas For Radio Amateurs** *by William Orr and Stuart Cowan* All New! Low-cost, multi-band antennas; inexpensive beams, "Invisible" antennas for hams in "tough" locations! New data. **$11.95**

AR2200 **Antenna Impedance Matching** *by Wilfred N. Caron* Most comprehensive book written on using Smith Charts in solving antenna impedance matching problems. **$20.00**

AR0410 **Yagi Antenna Design** A *Ham Radio* series polished and expanded by Dr. Lawson. **$15.00**

AR2995 **Reflections** will help dispel the half-truths and outright myths that many believe are true about transmission lines, standing waves, antenna matching reflected power and antenna tuners. **$20.00**

AR3118 **Reflections**—Software for IBM 5-1/4" **$10.00**

CODE TAPES

73T05 **"Genesis" $5.95 5 wpm**—This beginning tape, takes you through the 26 letters, 10 numbers, and necessary punctuation, complete with practice every step of the way.

73T06 **"The Stickler" $5.95 6+ wpm**—This is the practice tape for those who survived the 5 wpm tape, and it's also the tape for the Novice and Technician licenses. It is comprised of one solid hour of code. Characters are set at 13 wpm and spaced at 5 wpm.

73T13 **"Back Breaker" $5.95 13+ wpm**—Code groups again, at a brisk 13+ wpm so you'll be really at ease when you sit down in front of a steely-eyed volunteer examiner who starts sending you plain language code at only 13 per.

73T20 **"Courageous" $5.95 20+ wpm** Congratulations! Okay, the challenge of code is what's gotten you this far, so don't quit now. Go for the extra class license. We send the code faster than 20 per.

73T25 **"The Mind Boggler" $5.95 25+ wpm** Fiendishly generated by kindly old Uncle Wayne for hams with a strong need for self punishment. Once you've conquered 25 per let Unk know if you need a 50 wpm tape.

UHF/VHF/PACKET

ARTSCI **U.S.Repeater Mapbook** *by Robert Martin* The Guide for traveling radio amateurs. **$9.95**

TP001 **The Basic Guide to VHF/UHF Ham Radio** *by Edward M. Noll* Provides a first rate introduction to the 2.6 and 1.25 meter bands as well as 23, 33, and 70cm. **$6.95**

AR3959 **Your Packet Companion** Perfect for the packet newcomer. **$8.00**

AR3878 **Your VHF Companion** Explore the fascinating activities on the VHF bands, FM and repeaters, packet, CW & SSB, Satellites, ATV, transmitter hunting and more. **$8.00**

03R02 **RTTY Today** *by Dave Ingram K4TWJ* Most comprehensive RTTY guide ever published. **$8.50**

Uncle Wayne's Bookshelf Order Form

You may order by mail, telephone, or fax. All payments are to be in US funds. Allow 4 weeks for delivery. (Prices subject to change without notice if suppliers increase prices.)

Item	Title	Qty.	Price	Total
Shipping: All US orders add $5.00 shipping—shipped UPS. (Please provide street address.)			**SHIPPING**	
Make checks payable to "Uncle Wayne's Bookshelf."			**TOTAL**	

Foreign Orders: Choose one: ☐ surface shipping ☐ air shipping.
(Surface delivery may take 2 to 3 months.)

Note: The actual foreign shipping costs will be additional to regular shipping and handling fees.

Name ______________________________

Street ______________________________

City ____________________ State ________ Zip ________

TOTAL $ ____________ ☐ Check/Money Order

☐ AE ☐ MC ☐ VISA $10 minimum for credit card orders

Card # ____________________ Expiration Date ____________

Signature ____________________ Phone # ____________________

Telephone: (603) 924-4117 (800) 234-8458 FAX: (603) 924-8613 UW 09/95

Mail: Uncle Wayne's Bookshelf, 70 Route 202N, Peterborough, NH 03458

☐ YES! Send me 12 issues of *73* at the low rate of $19.97. (Save 43% of cover price.)
Canada add $7 plus $1.40 GST. Foreign add $9 surface; $42.00 airmail.

☐ YES! Send me 12 issues of *Radio Fun* at the low rate of $12.97. (Save 20% of cover price.)
Canada add $7 plus $.70 GST. Foreign add $12 surface; $36.00 airmail.

BOOKS FOR BEGINNERS

TAB4354 **The Beginner's Handbook of Amateur Radio, Third Edition** *by Clay Laster W5ZPV.* 395 pages. Wonderful book for newcomers. It is basic and well illustrated. Even if you have all the other ham handbooks, you'll still find this one useful. **$22.00**

W5GWNV **No-Code Video, Manual, Part 97 Rules** Learn how to be a ham radio operator. **$29.95**

W5GWNC **Technician Class License Manual: New No-Code** *by Gordon West* This book covers everything you need to become a Technician Class Ham. Every question and answer on the examinations is found in this one book. FCC Form 610 application. **$9.95**

XTAL-1 The Crystal Set Handbook by Phil Anderson WØXI. Want to give a kid an exciting present? Or maybe yourself? Crystal sets are alive and fun. Here's a whole book packed with crystal set circuits that anyone can build. Now start saving those oatmeal boxes, okay? 133 pages **$10.95**

Low Drain,
No Pain!
Dual
KENWOOD
Clones! Clones!
Cloning allows you to copy all memory channel information from one TH-79A(D) to another TH-79A(D)
TH-79A (Deluxe)
FM DUAL BANDER
Information at your fingertips. Everything you need to know about operating the new TH-79A(D) FM dual-bander (144MHz/440MHz) can be viewed in its unique dot-matrix LCD with alphanumeric display. No need for the manual. In addition to this innovative guide function, the TH-79A(D) sports a user-friendly menu system, providing easy access to the many powerful features of this slim-line handheld transceiver. Such as 82 non-volatile memory channels with ID, DTSS and page functions, and a DTMF memory function for autodial operation. Full-crossband duplex operation is available, as is the ability to receive two frequencies on the same band (VHF+VHF or UHF+UHF) simultaneously. And thanks to the FET power module, long hours of operation are possible on one charge. With the TH-79A(D), transceiver technology enters the 21st century.
Features
NEW 5-WATT VERSION NOW AVAILABLE
■ 2.7 approx. output (144MHz), 2W approx. output (440MHz) from MOS FET power module and supplied 6V battery; 5W approx. output using optional PB-34 ■ Dot-matrix LCD with menu/guide system
■ 82 non-volatile memory channels with ID
■ DTMF keypad with memory function
■ DTSS (Dual-Tone Squelch System) with page
■ Built-in CTCSS tone encoder/decoder ■ Automatic band change
■ Power-on call sign display ■ Auto repeater offset (VHF)
■ Wide-range flexible antenna ■ Input overvoltage warning
■ 3-position output power control
■ Auto power-off and battery save function ■ Time-out timer
■ Memory channel lock-out (scan mode)
■ Cross-band repeater function ■ Page answer-back function
■ Channel display function ■ Wideband receiver coverage, including AM receive on the aircraft band* ■ Clone function
■ Modifiable for MARS/CAP use**
Specifications guaranteed for Amateur bands only.
Permits required. Specifications guaranteed for Amateur bands only.
KENWOOD COMMUNICATIONS CORPORATION
AMATEUR RADIO PRODUCTS GROUP
P.O. Box 22745, 2201 E. Dominguez St., Long Beach, California 90801-5745
Customer support/Brochures (310) 639-5300
KENWOOD ELECTRONICS CANADA INC.
95ARD-1138
KENWOOD